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The total annual capacity for the production of open-hearth rails in the United States is now about 1,500,000 tons, the principal mill being that at Gary, which is turning out 500,000 tons; then Ensley, with 400,000 tons; Bethlehem, 200,000 tons; Colorado, 200,000 tons; Lackawanna and others of smaller capacity, 200,000 tons. The total capacity of all mills making open-hearth rails up to 1907 was less than 200,000 tons, and in that year production reached 252,700 tons. In 1908 it reached 567,000 tons, and in 1909, 1,256,000 tons. In the same year 1,806,600 tons of Bessemer rails were made. The Iron Trade Review says: "A new feature of the production statistics is the detailed statement of the alloyed rails made in 1909. This was probably an inconsequential feature in previous years. Of the 1909 production 50,505 tons are stated to have been alloyed rails, as follows:

Titanium	35,945
Manganese	1,028
Nickel-chrome	12,287
Nickel and electric	1,245
Total	50,505

Of this total, 36,809 tons were Bessemer steel and 12,696 tons open-hearth steel. It appears that greater effort has been made to improve the Bessemer rail by the use of alloys than the open-hearth rail."

Not long ago the general manager of a prominent western railway remarked that his company not only provides a school of instruction for its shop apprentices and requires them to take advantage of the opportunities for study, but arranges for them to do so during the daytime, and allows them regular wages for the time so spent. This remark followed a discussion of a source of instruction which is offered by another road to such of its employees as desire to devote a part of their spare time evenings to make up for a lack of school training, and was made with the same enthusiasm and satisfaction that the manager would have displayed in speaking of the excellence of the roadbed or train service of his system. He also made the statement that he expected to live to see the privilege extended to employees in other departments. The skeptical may say that such efforts are made for the selfish purpose of obtaining a sufficient supply of competent mechanics to keep the motive power and euipment of the company in good condition. However, in helping itself the company is also helping its men, for as a result of this instruction they are not only enabled to earn higher wages, but are also qualifying themselves better to discharge the responsibilities of citizenship and to advance in the social scale. Work of this kind is necessarily undertaken first by the more prosperous corporations. That there is no school of instruction, or pension system, connected with most railways is not because the officers and directors are less solicitous for the welfare of their employees, but rather because the railways in the latter group have not the means at their disposal. A railway corporation is organized primarily for the purpose of making returns to its stockholders on the money which has been invested in the property, and it cannot indulge in semi-philanthropic work until its obligations to its owners have been discharged. We do not predict that transportation companies will ever attempt to monopolize the philanthropic work of this country, but we believe that to the extent of their ability most of them endeavor to promote the general welfare of their employees. The particular merit of schools of instruction is that the benefits are reaped by the employees who especially need them.

The committee on flat spots still believes that the M. C. B. limit, 2½ in. under a 50-ton car, causes an abuse of the track structure which is hard to excuse. The experiment with a freight truck with flat wheels and gage for measuring the spring deflection will hardly be sufficient to convince the M. C. B. Association that the limit should be reduced, for the results of that experiment are very indefinite and do not go beyond a demonstration that flat spots do cause some excess pressure on the rail, which is already admitted. The measurement of this pressure by the deflection of bolster springs is liable to considerable error on account of the indirect action of the forces producing deflection and the irregular flexibility of the arch bars, bolts and bolster through which they are transmitted. A more satisfactory experiment could be made by using a similar gage in a pedestal truck of the Fox type, where the spring is directly over the journal and whatever deflection is caused by the flat spot is communicated through a rigid structure directly to the gage. Regardless of the size of the flat spots in chilled wheels, it is a fact that wholesale breakage of sound rails has been traced to shelled out spots on steel-tired wheels. On one road in the middle west there was a serious epidemic of this kind on the tender wheels of passenger trains, and it was necessary to work day and night in the wholesale replacement of wheels wherever shelled out spots occurred. The serious nature of this defect lies in the fact that the size of the flat spot continues to grow and will reach large proportions if the wheel is kept in service. On one of the transcontinental lines, in January of this year, a small shelled out spot was observed on a steel-tired wheel on a passenger car when it left the eastern terminal. As it proceeded west the size of the spot enlarged until ordinary inspection, or even casual observation of the rough riding of the car, should have

directed its removal, but it was allowed to proceed. On a single division in the western part of the run more than 200 sound rails were broken by the impact of this flat wheel, all of them within a distance of 14 miles. The rails which broke were 85 lb. section, in service two years; the fractures were straight and clean. When the wheel was finally removed the flat spot was found to measure 6 in. long and ⅝ in. deep. There were really two flat spots merging into one having a total length of 6 in., with a hump between them, and the maximum depth was ⅝ in. Such experiences as the two we have mentioned would indicate that more actual breakage of rails is caused by shelled out spots on steel-tired wheels under high speed passenger trains than by the small flat spots on cast wheels which are so carefully watched and gaged by the inspectors of freight cars in interchange traffic. The bad riding of passenger cars should be sufficient to detect defective wheels, and the inspection of these wheels at division points should be more rigid. On some roads it has been found necessary to place the inspection of tender wheels under the charge of the same men who inspect passenger car wheels, and this has resulted in the detection of many wheels which escaped the notice of the locomotive inspectors, who, in some way, had come to regard the condition of tender wheels as of slight importance. The relation of flat spots and shelled out spots to broken rails is intimate and direct, but the present importance of the subject lies in the fact that wheels with spots much larger than 2½ in. are allowed to run in high-speed passenger service, rather than that any positive demonstration has been made that a 2½ in. spot is dangerous.

STANDARD CROSS SECTIONS.

Every well-organized railway has its standard cross section for track. The uniformity and finish called for by the drawings are not always secured in execution on account of the great and apparently unnecessary expense of strict compliance with every detail. The most expensive of such details, both in labor cost and in the results obtained, is the requirement of an absolutely uniform distance from base of rail to top of roadbed. Except where embankments have not completed settling and in wet cuts, the constant tendency of all track is upward. This is apparent wherever opportunity offers for comparing present elevations of track with such monuments as depot floors and station platforms, which have retained their original elevations for a number of years. This upward tendency is, of course, due to the constant raising where track is resurfaced. As the track goes upward, that part of the subgrade beyond the ballast lines must also be raised if the slope, the width at subgrade and apparent depth of the ballast are maintained constant. Does this pay? In return for the constant labor of lining up the ballast at the foot of the slope and keeping the slope uniform, neat appearance is secured, which is, of course, a good advertisement among those passengers who ride on the observation car, but would not a much smaller amount of the money so expended be more effective if judiciously invested in printers' ink? The neat lines and slopes, which are prepared at such great expense, are destroyed in a few months by pedestrians and removal of grass and weeds from the ballast and their continual restoration is necessary. If it is admitted that such care is justified on first-class roads, which must present a neat appearance, the method of maintaining these constant dimensions is still open to question. As the track is raised, the subgrade outside of the ballast must also be raised. This is usually done with earth, which dams the water up under the bottom of the ballast, keeping the roadbed soft and increasing the frequency of resurfacing. Would it not be more economical to maintain the subgrade outside of the ballast at a constant elevation and let the apparent depth of ballast be the real depth, maintaining a constant top width and slope, with a variable bottom width? The width of the subgrade must be increased from time to time as the bank is raised, no matter which plan is pursued. Perfect drainage of track, although greatly to be desired, can seldom be obtained, but all methods should tend as far as possible in that direction. If the outer edges of the subgrade are to be raised with the track, then it should be done with porous material or drains should be provided at frequent intervals. Drains are difficult to keep open and constant porosity of filling material cannot be maintained unless it is frequently disturbed and cleaned. The method of least work is the most economical.

THE RAIL QUESTION IN GOOD HANDS.

Some time over two years ago the wheel and rail committee of the American Railway Association called a meeting, to which were invited presidents, general managers and other officers of the various rail manufacturers, for the purpose of a joint discussion of the rail question. It was announced at the opening of the meeting that a free and full discussion was desired. Every one taking part was expected to speak his mind without reserve, and that privilege was quite freely exercised. The result was something of an awakening as to the true situation regarding this subject, both on part of the makers and users of rails. The mutual understandings between the two parties that grew out of these meetings were the beginning of the greatest advance step toward better and more satisfactory rails of recent years. It was the initial move of what has since developed into a tacitly understood co-operation between makers and users of rails.

Instead of standing aloof from each other, as was formerly the case, and each accusing the other of being most to blame for rail failures, the dangers and damages resulting therefrom, they are working together for one common end, namely, rails of size, shape and grade of steel best suited to present needs for safety and economy. As investigation of the technical side of the rail question, relating to their manufacture and use, naturally falls to the engineering department of the railways, this whole subject has by general consent eventually fallen into the hands of the rail committee of the Engineering and Maintenance of Way Association. This committee consists of twenty or more of the leading civil engineers at present in active service throughout the country, and they are doing most excellent work. Part of their plans are to confer and co-operate with rail manufacturers in arrangements for tests and trials of rails in service, thus opening the way for each party to fully understand details on which the final welfare of rails depend, and for which the other may be responsible. By such mutual understanding and co-operation the best results are bound to be reached. Nearly every man, woman and child in active life, constituting the great traveling public, has a direct interest in any effort put forth to improve conditions and safety in travel. The traveling public may be regarded as a third party concerned in the rail question. On its behalf, it is gratifying to note that the best available engineering talent among railway men, as well as the most skilled workers in the art of rail manufacture, are jointly engaged in this most important undertaking.

All may rest assured that this matter is in competent hands, that investigations are being carried on in a thoroughly fair and reasonable manner, and that the outcome from such efforts will bring about betterments in rails and track construction, giving improvements and safety in

travel which will redound to the common welfare of all concerned.

THE OPEN-HEARTH RAIL AND THE NEW SECTIONS.

The report of the committee on rail indicates that specifications and rail sections are still in a far from satisfactory or settled condition. The more extensive use of open-hearth steel and of the new heavy base sections has served to complicate the subject and has not resulted in the production of the high-grade rails which were hoped for by both manufacturers and railways. The committee makes the surprising statement that as far as they know "No railway has purchased rails under the specifications approved by the American Railway Association, nor has any railway succeeded in buying rails during the past two years according to a specification entirely satisfactory to its engineers." All of the specifications under which rails have been rolled in that period have been compromises on the part of both parties with the general result that neither the manufacturer nor the railway has been entirely satisfied.

While the chemical composition of the open-hearth rail is in the main satisfactory, the principal defect is in its mechanical structure and the failure of these rails due to this defect has been a disappointment. The largest number of failures of such rails indicate physical defects, such as pipes, gas bubbles and unsound steel generally in the ingots. The Watertown tests were hardly necessary to demonstrate that sound rails cannot be made from unsound ingots, but with the conclusive evidence derived from those tests the committee is well sustained in its statement that the prime requisite in securing sound rails is first to secure the sound ingot. It would now seem to be more important to improve steel manufacture so as to prevent these physical defects in the ingots than to give so much attention to the demonstration that these imperfections exist, as that must be admitted.

The manufacturer is making little or no progress in this direction. It appears to be one of the regular accompaniments of the open-hearth process, as conducted in modern steel works, that it results in piped and unsound ingots. One explanation of this which has been offered takes accounts of the large mass of molten metal which fills the reservoir from which the ingots are poured. In the Bessemer converter the weight of metal in a blow is only 5, 10 or 15 tons, while in the open health process as much as 90 to 100 tons of molten steel is drawn into the ladle for filling the ingot molds, and it takes 25 to 30 minutes to empty it. During this time 25 or 30 rail ingots are poured, so that the rate is about one ingot per minute. The first ingots poured are from the steel in the bottom of the ladle, and the last from that at the top. The temperature of this large mass of metal varies as the level of the liquid steel goes down, with the result that the structure of the different ingots is different, and the principal difference is in the first few and the last few poured. Sufficient time is not always allowed for the chemical reactions to be completed and for the slag to collect on the surface. A portion of the gas and impurities, which are allowed to remain throughout the mass of steel in the ladle, are caught in the chilled portion of the ingot one or two inches from the surface, and in the rapid and heavy reduction of the rolling mill, this honey-combed structure in the ingot appears as seams of unsound steel in the rail.

These are matters for the manufacturer to consider in his effort to produce sound ingots of open-hearth steel. The committee believe that these details, such as temperature, time of holding in the ladle and amount of discard, should be left to the steel maker and not form a part of the specification. It also believes that the mills can furnish sound rails if proper care and sufficient time are taken in making the ingot. The defects due to piped ingots show themselves in piped rails, and these should be detected under the drop tests. It is not clear as to why so many piped rails should go into track if test pieces were completely broken so as to exhibit the fracture.

It is probable and unfortunate that the majority of open-hearth rails rolled in the past two years were not inspected by constant reference to a broken specimen from the drop test. The new specification recommended by the Maintenance of Way Association provides that the drop tests shall be made on pieces of rail rolled from the top of the ingot and that these test pieces shall be cut from the rail bar next to either end of the top rail. It also provides that test pieces which do not break under the first drop shall be nicked and tested to destruction. If any such test piece shows interior defects, the top rails from each ingot of that heat shall be rejected.

An inspection of this kind should determine approximately the percentage of rails which have pipe defects, and it should reject those which are liable to be broken in track by reason of such defects. The difficulty is that the principal mills have not agreed to manufacture rails under such inspection, and it is possible they may decline to do so after a specification with these requirements is formally adopted by the American Railway Association.

New rails are also a disappointment as to wear, and the committee states that a generally poor wearing rail is furnished. This is due to the low percentage of hardeners, carbon and manganese, which the manufacturers prefer to use in order more easily to meet the drop tests. The percentage of carbon is regulated by the amount of phosphorus it is possible to eliminate, and the committee admits that knowledge of the subject is too limited to fix a sliding scale for increasing carbon as the phosphorus decreases, but the new specification suggests that when lower phosphorus can be secured in Bessemer or open-hearth steel the carbon shall increase at the rate of 0.035 for each 0.01 reduction in phosphorus. It also makes the requirement that the percentage of carbon, manganese and silicon in an entire order of rails shall average as high as the mean percentage between the upper and lower limits.

Another means of preventing the practice of the mills from keeping both carbon and manganese as nearly as possible to the lower limits, is the regulation which is proposed for the deflection under the drop. Both the height of the drop and the amount of deflection are determined to some extent by the shape of the section as well as its weight per yard, and after this is standardized the relation of deflection to chemical composition must be determined so as to prescribe maximum and minimum limits. Some roads have already prescribed such limits of deflection and the committee on rail recommends that specifications should fix a minimum deflection to eliminate brittle rails and to secure greater uniformity of product and a maximum deflection to eliminate soft rails.

It appears to be too early to decide on new standard rail sections, as very few of the new patterns were laid in 1908. Practically none of the A. R. A. sections were laid in places where necessary information relating to them can be obtained. The rails laid in 1909 and 1910 have not been in long enough to show any decided superiority of any section. We understand that the majority of the rails laid during this time, especially by the lines west of Chicago, have been the A. R. A. section "A."

An unfortunate condition affecting these tests is the fact that the difference in section can be entirely destroyed by differences in chemical composition and by heat treatment and mill methods. The statistics obtained from the

tests of the heavy base section are not encouraging, as many of them have broken the same as the older sections. There is, however, no lack of faith in the correctness of the conclusion that the heavy base is better suited to the heat conditions in rolling, that straighter rails are obtained on the cooling bed, and that these are subject to less local stress by the gagging press.

On account of the difficulties in getting accurate information from the track tests, the committee has decided to adopt the laboratory method, just as the motive power officers have resorted to shop or test-room methods of testing locomotives, because they were unable to get accurate measurements under service conditions. The rail committee has arranged for a series of tests on rail of different sections and weights, both Bessemer and open hearth, made by different mills, with a uniform chemical composition for each kind of rail. The tests will include drop tests and wearing tests on the revolving machine at Steelton and on the reciprocating machine at Sparrow's Points, besides a service test on track. Max H. Wickhorst, engineer of tests of the Burlington, has been appointed chief chemist in charge of these tests, and has been given a year's absence from the Aurora laboratory in order to take up this special work. As the result of this investigation, which will doubtless extend over a period of years, important facts relating to rail composition, rail manufacture and rail wear will be brought out, and it will be possible to fix in the specification the limits which are now uncertain. The rail manufacturer will have a better knowledge of why rails fail and he may change his methods in order to prevent failure or rapid wear, but these changes or improvements will only be made to the extent to which they are profitable. The principal defects in rail manufacture may nearly all be traced to the same cause—too rapid work. This is also the principal cause for large profits in manufacture. This presents a condition difficult to change. That such rapid work is not now made necessary by the relation of demand to practicable supply can be shown by a few round figures. The maximum capacity of the rail mills of the United States is now at least 4,000,000 tons per annum. The amount required for new track will not average more than 1,000,000 tons, and for wear during years of maximum tonnage 1,000,000 tons, while trolley lines, export business and rails for miscellaneous purposes will not require more than 1,000,000 tons, making the total average consumption per annum only three-fourths of the total capacity of the mills. The increase in furnace and mill capacity, which is constantly being made, is greater proportionately than the increase in consumption. Under these conditions it should be possible to secure the more deliberate methods in manufacture which are essential to an improvement in the quality of rails.

DISTURBING FACTORS IN LOCOMOTIVE CAPACITY AND TRAIN RESISTANCE.

The committee of the Maintenance of Way Association on "Economics of Railway Location" devotes nearly 50 pages of its report to a consideration of "Power and Resistance," having reference to the net hauling power of the locomotive and the resistance of trains. The report contains the latest and best information on the subject, in the form of curves, tables and formulæ, making it a valuable compendium for those who find it necessary to resort to calculation in order to determine the useful hauling power of a locomotive, or the resistance of trains.

The first conclusion of the committee is that the actual drawbar pull of the locomotive at various speeds should be used in making estimates with reference to economic value of various locations of line and grade, and that when not known it should be calculated. Considering the various disturbing factors which the report points out and others which it does not mention, it is a question as to whether it would not be best to obtain the actual power of a similar or equivalent locomotive in actual practice rather than depend upon the uncertainties of calculations employing even the best and most recent formulæ. We have termed these uncertainties disturbing factors, and the text of the report furnishes a good opportunity to point out some of the principal ones connected with the calculation of the tractive power of locomotives and the resistance of trains.

The quality and quantity of fuel which can be properly fired are first considered, and it is pointed out that in various parts of the United States the thermal value of coal varies from 10,000 to 15,000 B. T. U., or as 2 to 3, one having an evaporative value 50 per cent. greater than the other, or, one having a heat value one-third less than the other. As the fireman cannot handle any more of the lower grade coal in a given time than of the higher, the boiler will deliver a larger amount of steam with the high-grade coal under equal firing.

The report suggests that such differences be equated by rating the steam capacity of the engine in proportion to the heat units in the fuel, but in the same paragraph it explains that the quantity of ash and tendency to clinker would affect the heat value to an uncertain degree beyond the relative value in B. T. U. For this reason, it would not only be advisable to get the drawbar pull from actual test, but to use in the test a grade of coal which would represent the average quality of the coal supply on the line whose economical location is under survey.

The report makes the surprising statement that one of the most important points affecting the steam-generating capacity of a locomotive is the ratio of heating surface to grate area, and diagrams and tables are given to show how the evaporation per square foot changes with different values for this ratio. The table gives maximum evaporation per square foot for a ratio of 1:50, which would give a locomotive 2,500 sq. ft. heating surface for a grate 50 sq. ft. area, but modern locomotives with 50 sq. ft. grate have 3,500 to 4,000 sq. ft. heating surface, or a ratio of 1 to 70 and 1 to 80, and the figures in the table for such ratio indicate an evaporation of only two-thirds that of the smaller ratio. While it is important to point out that heating surface in locomotives has a value which varies in some way with its relation to the grate area, the attempt to give exact values for such ratios is misleading and would be differently reported by every different experimenter. The attempt to take account of the difference in ratios of grate to heating surface in estimating the power of a locomotive, while correct in principle, should be accompanied by far more exact knowledge of the laws governing it than we now possess and would only introduce another disturbing factor, which, unfortunately, prevents exact or satisfactory calculations of this kind.

The variation in the strength and skill of different firemen and the gradual decline of that strength in individuals, is another disturbing factor which has such an effect on locomotive performance as to either make the tonnage rating lower than it could be if the fireman's work was well sustained throughout the run, or to prevent the schedule time from being maintained, by reason of low boiler pressure, due to poor firing. The report says it is a common experience for firemen to become exhausted in the heat of summer in an attempt to handle the average rating. It gives 4,000 lbs. per hour as a fairly high amount of coal to be properly fired. For short periods, after a rest at a station, the fireman will occasionally do better, but a study of the dynamometer record often reveals the point where the fireman gradually tires and finally comes down

to his normal capacity for a long run. This is one of the variables which even a practical test in service will not eliminate, and the suggestion that the firing of 4,000 lbs. of coal per day be taken as a standard for grading the strength of firemen and as a rate for coal combustion for normal boiler performance is one which can be followed with advantage in the effort to eliminate uncertainties.

The condition of the smoke box draft appliances and of the valve motion easily affect the steaming of the locomotive and the performance generally, and these are matters which no calculation can take account of and must be measured by their effect on the actual performance of the locomotive. Results of the tests of locomotives in the laboratory testing plants are useful in getting comparative efficiencies for different engines or for various changes in proportions or details, but the relation of such efficiencies to those obtained on the road are also uncertain. In a paper on fuel economy in testing plants and railways, by H. H. Vaughan, read at the November, 1909, meeting of the Western Canada Railroad Club, the conclusion was reached that with freight trains on the Canadian Pacific in July, the locomotive efficiency as a whole was within 25 per cent. of that obtained in a testing plant. The report suggests that the various losses in road operation due to radiation, leakages, steam auxiliaries, etc., would reduce the actual useful steam produced at least 5 per cent. less than that shown by testing plant, but no factor for a reduction of the whole locomotive efficiency, due to losses in service, is offered.

Much of the data in articles by F. J. Cole, consulting engineer, American Locomotive Company, and published in the Railroad Age Gazette,* is included in the report now under review, but the committee prefers to recommend factors somewhat different from those in Mr. Cole's articles. Thus, for the frictional resistance of the machinery of the locomotive, the factor 22.65 is used, instead of 22.2, as given by Mr. Cole, who multiplied this by weight on drivers regardless of the number of driving axles. The report suggests that greater accuracy would be obtained if not only the weight on drivers but the number of axles be considered, and a table based on this view is included in the report. The resistance of driving machinery is obtained by the formula: $R = 18.7\ T + 80\ N$, where R = resistance in pounds; T = tons weight on drivers and N = number of driving axles. For the engine and tender trucks, $R = 2.6\ T + 20\ N$, where T = tons weight on engine and tender trucks and N = number of truck axles. The factor of head-end resistance is the same as given by Cole, $.002\,V^2$ per square foot area, but this area is taken as 125 sq. ft., instead of 120, used by other authorities.

The uncertainties connected with the predetermination of the resistance of cars is shown by the variety of factors and formulæ used in tonnage rating on different roads, but there is now a much closer agreement than formerly, and the recent dynamometer work has been much more accurate. The record obtained by dynamometer car for loaded freight cars of a given design on one road can be be depended on for close reproduction on another road, and wider variations will be found from mixed and empty trains, where air resistance has more influence per ton weight of cars.

For passenger trains the uncertainties and disturbing factors are greater, due to the effect of speed on head end and flange resistance caused by air pressure. The changes in atmospheric conditions, the velocity and direction of the wind, have more effect at higher speeds and render passenger train resistance quite variable and accurate determination impossible. This, however, is not so important, as the tonnage of passenger trains is easily regulated by actual performance and overloading is soon detected by a failure to make schedule time.

While the Maintenance of Way report on locomotive power and train resistance is the best treatment of the subject we have seen, and the tables and curves are so convenient as to make calculations easy, we have endeavored to point out that they must not be regarded as a close approach to accuracy, and it is always more desirable to obtain locomotive drawbar pull at different speeds directly from actual practice rather than by calculation from the best data and formulæ.

*See Railroad Age Gazette, August 27 to October 1, 1909.

EFFICIENCY DEVICES IN TRACK WORK.

In line with the broad general policy of this paper to promote efficiency in all departments of railway service, we announced a prize competition, last winter, for efficiency-producing devices or ideas in track work. A large number of manuscripts were submitted to us, and we were fortunate in securing the services of Messrs. J. W. Kendrick, vice-president of the Atchison, Topeka & Santa Fe, J. D. Isaacs, consulting engineer of the Union Pacific-Southern Pacific System, and J. B. Berry, chief engineer of the Rock Island, as a committee of award. We publish herewith the committee's decision, in the form of a letter from Mr. Kendrick.

Chicago, March 5, 1910.

To the Editor of the Railway Age Gazette—Messrs. Isaacs, Berry and the writer devoted some time to-day to the consideration of the paper submitted in the competition suggested by the Railway Age Gazette pertaining to descriptions and illustrations of tried expedients and methods in connection with track maintenance, and we report, with a great deal of regret, that we did not find any of the papers submitted sufficiently meritorious to warrant either the award proposed by your paper or publication therein. We feel that, notwithstanding the wide distribution of the Railway Age Gazette, there are many railway officers and sub-officers who do not read it, or who, because of claims upon their time, and perhaps some natural diffidence, have not submitted papers in relation to many topics which would be interesting, and, at the same time, very important to your thousands of readers. We beg to suggest that the announcement be put in form of a leaflet and sent to the proper executive officer of each one of, say, twenty railways, and that you ask the co-operation of these railway officers in bringing the matter to the attention of the members of their organization in the belief that such course will result in enabling you to publish a number of articles upon devices and practices which will be valuable to the railway profession, and which may not be, and probably are not, generally used at this time.

The articles that you have published under the general caption of "Shop Kinks" elicited much of value to shop superintendents, foremen and mechanical men in general. If this course is adopted, we believe that roads should be chosen so as to represent the entire territory within the boundaries of the United States. Perhaps twenty roads are too many to enlist in the beginning, because a considerable number of meritorious papers should be forthcoming. If this policy is pursued, and, as the number of prizes is necessarily limited, it will, if there is a general response, necessitate considerable labor in order to determine relative merit, and will, at the same time, result in disappointing some of the contestants. Perhaps it would be better to confine this experiment to eight or ten roads. In each case a sufficient number of the leaflets should be sent to each officer addressed to enable him to give them wide distribution among superintendents engineers, mainte-

nance of way, roadmasters, section foremen, and so forth. The composition of the replies should not be too closely criticized, and the expressions of our feelings that have evidently reached you would not be justified if it were not for the fact that the contestants in the cases submitted to us were all young engineers, and some of them, especially the one who states that he graduated from the best engineering institution in the country a few years ago, should certainly have made a very much better showing in the composition of their articles.

We are sorry that we could reach no other conclusion with respect to these offerings than outlined herein, but it seems to use that it would be a mistake to start an undertaking of such merit on such a low standard. The documents will be returned to you on Monday by messenger.

Trusting that the suggestions contained herein may be of some value, at least to the extent of suggesting a method of procedure which will result in the accomplishment of your purpose, I am, on behalf of my associates and myself, J. W. KENDRICK.

We concur heartily in the recommendations of the committee, and shall put them into effect as soon as possible.—Editor.

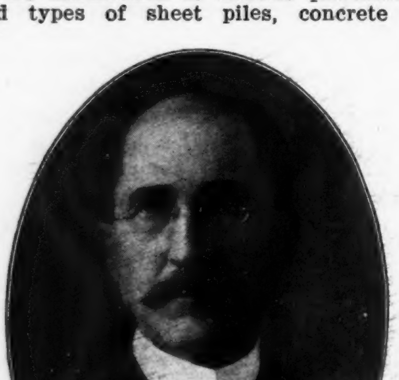
WOODEN BRIDGES AND TRESTLES.*

The work assigned by the board of direction was:

(1) Consider revision of Manual; if no changes are recommended, make statement accordingly.

(2) Continue the revision of the specification for structural timbers, co-operating with Committee Q of the American Society for Testing Materials and committees of other associations on the subject, with a view, if possible, of preparing a uniform standard specification.

(3) Continue the study of principles and methods of pile-driving, the subdivision to include pile-driving records, recommended types of sheet piles, concrete piles, pile-driving formulas, recommended types of equipment, shoes, splices, etc.



H. S. JACOBY.

(4) Prepare a set of definitions relating to specifications for timber, supplementing definitions of defects, but more comprehensive than heretofore.

Sub-Committees.

The following sub-committees were appointed:

A. To consider item 4, in the outline of work, and that part of item 2 which relates to Southern yellow pine. F. H. Bainbridge, chairman; F. B. Scheetz, C. C. Wentworth.

B. To consider item 2, with reference to the preparation of standard specifications for Douglas fir and Western hemlock: G. A. Casseday, chairman; F. H. Bainbridge, L. J. Hotchkiss, Hans Ibsen, James Keys.

C. To consider item 3: R. D. Coombs, chairman; F. E. Bissell, J. A. Lahmer, F. B. Scheetz, W. F. Steffens, C. C. Wentworth, P. H. Wilson.

D. To consider item 1: James Keys, chairman; W. S. Bouton, G. R. Talcott.

The vacancy in the chairmanship of Sub-Committee B, due to the death of G. A. Casseday on July 20, 1909, was filled by the appointment of L. J. Hotchkiss.

Revision of the Manual.

Some amendments of recommended standard definitions are offiered, as well as amendments of two paragraphs in the specifications for metal details used in wooden bridges and trestles (see Appendix A).

The specifications for bridge and trestle timber and piling in the Manual, 1907, pp. 80-83, are superseded by others adopted later. The safe unit-stresses, on page 85, are also superseded by those adopted in 1909. Some other amendments relating to specifications to be inserted in the Manual are given under subsequent topics.

Standard Specifications for Bridge and Trestle Timbers.

The designations adopted for the two grades of Southern yellow pine at the last convention (see Proceedings, Vol. 10, p. 614) proved unacceptable to the Yellow Pine Manufacturers' Association, and at a joint conference of committees the designations "Standard Heart Grade" and "Standard Grade" were agreed on. It was also agreed to substitute "corner" for "edge," since the latter is employed as a technical term in the lumber trade, having a different meaning from that in ordinary usage; and to insert the requirement of having the timber sawed to full length. With these modifications the specifications were adopted August 4, 1909, by the Yellow Pine Manufacturers' Association, printed in pamphlet form, and issued to the trade with the request to put them into effect. It is to be remembered that the American Society for Testing Materials, through its Committee Q, on standard specifications for the grading of structural timbers, has actively co-operated to secure this result.

The committee emphasizes the importance of careful inspection. It is unfair to any honest manufacturer, who submits a bid on the basis of the face value of the specifications, if the purchaser finally accepts material which is inferior in quality to that demanded by a reasonable interpretation of the specifications.

At the last convention the committee withdrew all references to Douglas fir and Western hemlock, believing it to be impracticable to frame satisfactory specifications to apply in common to these species and to Southern yellow pine. Separate specifications, relating to Douglas fir and Western hemlock, are now presented for approval (see Appendix C).

Some of the existing specifications are too strict, and timber conforming to their requirements cannot be purchased except at excessive prices. It has been the purpose to frame a specification which will secure a good grade of timber and which is thoroughly practicable from a manufacturer's standpoint.

The chairman of the sub-committee is endeavoring to arrange for a meeting with representatives of the Oregon and Washington Lumber Manufacturers' Association and the Pacific Coast Lumber Manufacturers' Association, and of the American Society for Testing Materials, to secure, if possible, a uniform standard specification.

It was decided that the specifications shall cover only two grades of timber. The standard heart grade is intended for general use in bridges and trestles, while the standard grade is intended for false-work trestles for filling and for other temporary construction. White Douglas fir is excluded in the standard heart grade and accepted in the standard grade since it is not regarded as sufficiently durable for use in other than temporary structures. The limiting sizes given for pitch pockets and knots are believed to be readily met by the manufacturer, and that the quality specified will be satisfactory to the user. The general form of the specifications is similar to that adopted last year by the association.

As to whether the percentage of heart for different members of a structure should be specified, the committee concluded that, while this may not be necessary at present, the specifications to be adopted by the association will probably stand for a number of years, and, since the time may come soon when heart wood cannot be so easily secured, the percentage of heart should be designated.

Definitions Relating to Structural Timber.

Definitions heretofore adopted relate chiefly to standard defects (see Manual, 1907, pp. 72-79). Most of the defini-

*From a report presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association.

tions now submitted were prepared last year, a few having been revised this year and several others added (see Appendix D).

Piles and Pile Driving.

The report submitted in Appendix E is a continuation of that of last year. The paper on The Supporting Power of Piles, given in Appendix F, was prepared by E. P. Goodrich, at the request of the committee.

Strength of Redwood Timber.

In Appendix G is given an abstract of an unpublished progress report by the United States Forest Service, dated March 31, 1909. This abstract is published for the information of members of the association as a valuable addition to the relatively meager results heretofore available upon the subject. However, since the number of tests is somewhat limited and the timber is taken from only one district, it is not deemed advisable to recommend any revision at present of the working unit-stresses for redwood.

Conclusions.

The committee recommends the adoption of the following conclusions:

(1) That the proposed amendments relating to specifications, etc., in the Manual of Recommended Practice, be adopted.

(2) That the standard specifications for Douglas fir and western hemlock bridge and trestle timbers be adopted and published in the Manual of Recommended Practice.

(3) That the definitions for structural timber be referred to the board of direction, with the recommendation to publish them in the Manual of Recommended Practice.

(4) That the report on piles and pile driving be received as information.

The report is signed by: Henry S. Jacoby (Cornell University), chairman; James Keys (Un. Pac.), vice-chairman; F. H. Bainbridge (C. & N. W.), F. E. Bissell (consulting engineer), W. S. Bouton (B. & O.), R. D. Coombs (Penna. Tun. & Term.), L. J. Hotchkiss (C., B. & Q.), Hans Ibsen (Mich. Cent.), J. A. Lahmer (K. C. Sou.), F. B. Scheetz (Mo. Pac.), W. F. Steffens (B. & A.), G. R. Talcott (B & O.), C. C. Wentworth (N. & W.) and P. H. Wilson (civil engineer).

Appendix A.

Proposed Definitions.

Wooden Bridges and Trestles.

Post.—One of the vertical or battered members of the bent of a framed trestle.

Pile.—(See definition under subject of Piles and Pile Driving.)

Sub-Sill.—A timber bedded in the ground to support a framed bent.

Jack Stringer.—A stringer placed outside of the line of main stringers.

Guard Rail.—A longitudinal member, usually a metal rail, secured on top of the ties inside of the track rail, to guide derailed car wheels.

Guard Timber.—A longitudinal timber framed over the ties outside of the track rail, to maintain the spacing of the ties.

Fish-Plate.—A short piece lapping a joint, secured to the side of two members, to connect them end to end.

Bulkhead.—A wall of timber placed against the side of an end bent to retain the embankment.

Piles and Pile Driving.

Batter Pile.—One driven at an inclination, etc.

Leads.—The upright, etc.

Cap.—A block used to protect the head of a pile and to hold it in the leads during driving.

Follower.—A member interposed between the hammer and a pile to transmit blows to the latter when below the foot of the leads.

Standard Defects of Structural Timber.

Wane.—See definition under the subject of Structural Timber.

Note.—See additional definitions of defects under Structural Timber.

Specifications for Metal Details Used in Wooden Bridges and Trestles.

In the Manual of 1907, pp. 83 and 84, amend paragraphs 2 and 3 on steel and cast-iron, respectively, to conform to the specifications for iron and steel structures in paragraphs 83-85, and 106, on pp. 267 and 270 of the Manual.

Appendix C.

Standard Specifications for Douglas Fir and Western Hemlock Bridge and Trestle Timbers.

(To be applied to single sticks and not to composite members.)

1. Standard heart grade shall include yellow and red Douglas fir and western hemlock. White Douglas fir will not be accepted.

2. General Requirements.—All timber shall be live, sound, straight and close grained, cut square cornered, full length, not more than ¼ in. scant in any dimension for rough timber or ½ in. for dressed timber; free from large, loose or unsound knots, knots in groups, or other defects that will materially impair its strength for the purpose for which it is intended. Subject to inspection before loading.

3. Stringers shall show not less than 90 per cent. heart on each side and edge, measured across the surface anywhere in the length of the piece. Shall be out of wind and free from shakes, splits, or pitch pockets over ⅜ in. wide or 5 in. long. Knots greater than 2 in. in diameter will not be permitted within one-fourth of the depth of the stringer from any corner nor upon the edge of any piece; knots shall in no case exceed 3 in. in diameter.

4. Caps, sills and posts shall show not less than 85 per cent. heart on each of the four sides, measured across the surface anywhere in the length of the piece. Shall be out of wind and free from shakes, splits or pitch pockets over ½ in. wide or 5 in. long. Knots shall not exceed one-fourth of the width of the surface of the piece in which they occur and shall in no case exceed 3 in. in diameter.

5. Longitudinal struts or girts, X braces, sash and sway braces shall show one side all heart, the other side and two edges shall show not less than 85 per cent. heart, measured across the surface anywhere in the length of the piece.

6. Ties and guard timber shall show one side and one edge all heart, the other side and edge shall show not less than 85 per cent. heart, measures across the surface anywhere in the length of the piece.

7. Timbers for Howe truss chords shall show not less than 90 per cent. heart on each side and edge, measured anywhere in the length of the piece. Shall be out of wind and free from shakes, splits or pitch pockets over ⅛ in. wide or 3 in. long. Knots shall not be over 1½ in. in diameter nor be closer together on each surface than one in any four linear feet, but if knots are 1 in. or less in diameter, one in any three linear feet will be allowed.

8. Standard grade shall include yellow, red and white Douglas fir and Western hemlock.

9. General Requirements.—All timbers shall be sound and cut square cornered, except that timbers 10x10 in. in size may have a 2-in. wane on one corner or its equivalent on two or more corners. Other sizes may have proportionate defects. Must be free from defects which will impair its utility for temporary work. Knots shall not exceed one-fourth the width of the surface of the piece in which they occur. Subject to inspection before loading.

10. Stringers, caps, sills and posts shall be out of wind, free from shakes or splits extending over more than one-eighth of the length of the piece, or knots more than 4 in. in diameter. Knots greater than 3 in. in diameter will not be permitted on the edge of any stringer.

Appendix D.

Structural Timber—Definitions.

Timber.—A single stick of wood of regular cross-section.

Cross-Section.—A section of a stick at right angles to the axis.

True.—Of uniform cross-section. Defects are caused by wavy or jagged sawing or consist of trapezoidal instead of rectangular cross-sections.

Axis.—The line connecting the centers of successive cross-sections of a stick.

Straight.—Having a straight line for an axis.

Out of Wind.—Having the longitudinal surfaces plane.

Corner.—The line of intersection of the planes of two adjacent longitudinal surfaces.

Girth.—The perimeter of a cross-section.

Side.—Either of the two wider longitudinal surfaces of a stick.

Edge.—Either of the two narrower longitudinal surfaces of a stick.

Face.—The surface of a stick which is exposed to view in the finished structure.

Sapwood.—A cylinder of wood next to the bark and of lighter color than the wood within. It may be of uneven thickness.

Heartwood.—The older and central part of a log, usually darker in color than sapwood. It appears in strong contrast to the sapwood in some species, while in others it is but slightly different in color.

Springwood.—The inner part of the annual ring formed in the earlier part of the season, not necessarily in the

spring, and often containing vessels or pores.

Summerwood.—The outer part of the annual ring formed later in the season, not necessarily in the summer, being usually dense in structure and without conspicuous pores.

Decay.—Complete or partial disintegration of the cell walls, due to the growth of fungi.

Sound.—Free from decay.

Solid.—Without cavities; free from loose heart, wind shakes, bad checks, splits or breaks, loose slivers and worm or insect holes.

Wane.—A deficient corner due to curvature or to taper of the log.

Square Cornered.—Free from wane.

Knot.—The hard mass of wood formed in a trunk at a branch, with the grain distinct and separate from the grain of the trunk.

Cross-Grain.—The gnarly mass of wood surrounding a knot, or grain injuriously out of parallel with the axis.

Wind Shake.—A crack or fissure, or a series of them, caused during growth.

Appendix E.

Piles and Pile Driving.

This appendix shows several forms of blanks for keeping pile driving records, illustrates various pile splices and shoes and discusses over-driving. After illustrating types of mechanical protection against marine borers, it takes up concrete piles, describing several designs.

The chief objection to cast-and-driven concrete piles has been based upon the possibility of injury to the reinforced concrete during driving. Most of the systems in vogue care for this by jetting the piles, or by the use of a special driving cap designed to protect the head of the piles. The patents covering these various systems refer principally to the driving caps, the arrangement of the reinforcement, provision for jetting, method of molding, and the shape of the pile itself. All of the items entering into the manufacture and placing of cast and driven piles may be varied to suit the local conditions.

It is estimated that about 2,500,000 linear feet of cast-in-place piles are now in use in this country. No definite data in regard to the use of cast-and-driven piles could be obtained, but the quantity is believed to be less than 250,000 linear feet.

Wooden piles are loaded to about 15 tons, and while many engineers think they are capable of carrying greater loads, this load represents conservative practice. The loads allowed on concrete piles vary from 25 to 50 tons each, depending on the nature of the ground and the system used; in European practice they are loaded to 40 or 50 tons each, and there are records of piles loaded to 80 tons; the best American practice, however, limits the load to 35 tons.

To prevent decay wooden piles are cut off at low water and the foundations must be carried down to this level. The tops of concrete piles may be at any elevation desired and the depth of the footing course will be governed by the spacing of the piles, and the weight of the superstructure. In this way the expensive excavation for deep footings, as well as the cost of the additional depth of footings, is saved.

Concrete piles cannot be driven as rapidly as wooden piles, but since the load per pile is greater, their use may result in a saving of both time and cost. If concrete piles are used, no delay is occasioned by waiting for the arrival of the piles; wooden piles are difficult to obtain in certain parts of the country, but sand, stone and cement are generally available. There is no reason why concrete should vary in quality, while it is becoming more and more difficult to obtain wooden piles of a standard grade.

A wooden pile rots if alternately wet and dry and is subject to attack by the teredo and other wood borers, when placed in salt water. The elevation of ground water fixes the point of cut-off, but the building of deeper sewers in the neighborhood may lower the ground-water level, and when this occurs wooden piles are subject to decay.

The argument most frequently urged against concrete piles is their cost. The cost per linear foot is certainly greater for a concrete pile than for one of wood, but when the saving in excavation, size of footings, number of piles and time of completion are taken into consideration, this additional cost per foot is discounted.

The length of cast-in-place piles is limited, but piles cast and driven may be of any length. When driven with a core or pipe, the maximum length thus far attained is 45 ft.; no cores have been made longer than this, while the difficulty experienced in pulling the pipe, renders a greater length impracticable.

Cast-and-driven piles require careful handling if made in long lengths, as cracks cannot be readily detected, and the piles should preferably be allowed to set several weeks before using. If made on the job this delays the work, while if made in distant yards, the exact lengths are hard to gage, and the piles may be either too short or too long. As the operations of lengthening or shortening cause delay and expense, it is very desirable that the penetration be determined before the piles are brought to the site.

If shells are used, they should be made of steel heavy enough to withstand the side pressures of soft ground or the shearing effect of boulders or gravel. Some objection has been made to dropping concrete through the longer lengths of a cast-in-place pile. As a wet mixture is used, and the concrete is deposited by shovels, it should be properly graded when the pile form is full.

The driving of an adjacent pile tends to settle the concrete in the pile just filled, thus forcing out the air bubbles, and while distortion may occur, particularly in the case of piles driven without a shell, this danger has not been manifest in actual practice.

In cast-in-place piles, unprotected by a shell, it is impossible to inspect the integrity of the pile. After the concrete leaves the end of the pile, it is subjected to the action of the surrounding ground without protection. Soils bearing running water may carry off a part of the cement, leaving the coarser aggregates; very dry, porous soils may absorb the water needed in setting; in either case the bearing power of the pile would be affected.

As in the case of peeled wooden piles, a smooth exterior offers less resistance to movement than a rough one. However, when the attempt is made to increase the skin friction by cementing the pile to the earth in which it is cast, a question arises as to how much the pile itself is weakened by an admixture of earth. The necessity of reinforcing concrete pile in certain soils is apparent, and the greater the dependence placed upon point bearing, the greater the necessity for reinforcing.

A pile depending on point bearing acts as a column, supported more or less at the sides, and any pile acting as a column should be reinforced. When subjected to bending stresses or placed in semi-liquid or shifting soil, piles should be reinforced. Piles whose method of manufacture precludes the insertion of reinforcement are not adapted to use in service which requires action as a column.

Appendix G.

Strength of Redwood Timber.

The following abstract is made from a progress report by the United States Forest Service, dated March 31, 1909, the tests having been made in co-operation with the Redwood Association. The material was selected by a member of the Forest Service, assisted by experienced mill men, an attempt being made to represent the various qualities occurring in commercial material and in amounts proportional to the general output.

The trees were felled in February, 1908, in Central Mendocino county, Albion district, California, and shipment to the laboratory included 4,867 ft. of sawed lumber in 70 pieces, with sizes ranging from 2x8 in. to 8x16 in., and 16 ft. long.

The beams tested were loaded at the third points, the average percentage of moisture being 68.1, the average results for 21 beams ranging in section from 7x9 to 8x16 in. and a span of 15 ft., expressed in lbs. per sq. in., are 4,210 for the extreme fiber stress at the elastic limit, 5,190 for the ultimate stress in the outer fiber, 260 for the longitudinal shear and 1,249,000 for the modulus of elasticity. The corresponding values for 24 beams from 2x8 to 3x14 in. and a span of 15 ft., are 3,160, 4,240, 190 and 1,030,000. By comparing the larger sizes the strength of redwood in flexure expressed as a percentage of that of Douglas fir is 96 at the elastic limit, 81 for the ultimate stress in the outer fiber, and 74 for the modulus of elasticity.

The average results for the elastic limit in compression on the side of the fibers are as follows: 19 tests on sticks, 7x9 to 8x16 in. in cross-section, give 470; 43 tests on sticks 2x8 to 8x16 in., give 450; and 113 tests on sticks 2x2 to 8x16 in., give 550 lbs. per sq. in. All the sticks were 24 in. long and contained an average of 65.7 per cent. of moisture.

For compression parallel to the grain the following average results are obtained: For 17 tests on blocks 6x6 in. and 20 in. long, the elastic limit is 3,270, and the ultimate stress is 4,160 lbs. per sq. in.; and for 70 tests on 2x2-in. blocks, 6 in. long, the corresponding values are 3,560 and 4,150 lbs. per sq. in. The average percentage of moisture is 76. For a comparison of the larger sizes the strength of redwood is 111 per cent. of that of Douglas fir.

IRON AND STEEL STRUCTURES.

The committee recommends that certain revisions be made in the Manual of Recommended Practice (1907) and that the General Specifications for Steel Railroad Bridges (1906), printed in pamphlet form, be revised so as to correspond therewith.

It presents the proposed modifications in two groups. The first includes minor changes in punctuation, words and construction of sentences, which do not affect the

J. E. GREINER.

substance. The second consists of important changes, additions to or revisions which affect the substance.

The second group, the important changes are as follows:

For paragraph 2, p. 257 of the Manual, substitute:

2. When alinement is on tangent, clearances shall not be less than shown on the diagram. The width shall be increased so as to provide the same minimum clearances on curves for a car 80 ft. long, 14 ft. high, and 60 ft. center to center of trucks, allowance being made for curvature and superelevation of rails.

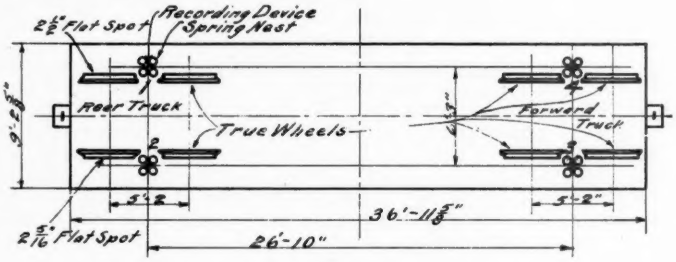


Fig. 1. Positions of Recording Devices.

6. Make addition so that the paragraph will include "reinforced concrete [assumed to weigh] 150 lbs. per cu. ft."

13. Omit marginal reference and substitute: Structures located on curves shall be designed for the centrifugal force of the live load applied at the top of the high rail. The centrifugal force shall be considered as live load and be derived from the speed in miles per hour given by the expression 60 — 2½ D, where D = degree of curve.

Substitute:

16. Axial compression on gross section of columns —

$16,000 - 70\frac{l}{r}$

with a maximum of........................14,000

where "l" is the length of the member in inches, and "r" is the least radius of gyration in inches.

Direct compression on steel castings........16,000

17. Add "and steel castings" after "girders."

19. Substitute in place of the figures now given for, "granite masonry and Portland cement concrete" and "sandstone and limestone" the following:

On masonry 600

Insert the following new paragraphs after paragraph 19:

19-a. The lengths of main compression members shall not exceed 100 times their least radius of gyration, and those for wind and sway bracing 120 times their least radius of gyration.

19-b. The lengths of riveted tension members in horizontal or inclined positions shall not exceed 200 times their radius of gyration about the horizontal axis. The horizontal projection of the unsupported portion of the member is to be considered as the effective length.

21. Omit marginal heading. Change "70 per cent." in the second line to two-thirds.

27. Add to this paragraph: "The thickness of web plates shall be not less than 1-160 of the unsupported distance between flange angles (see 36).

28. Make additions shown so that the paragraph will read: "The gross section of the compression flanges of plate girders shall be not less than the cross section of the tension flanges; nor shall the stress per sq. in. in the compression flange of any beam or girder exceed $16,000 - 200\frac{l}{b}$, when flange consists of angles only or if cover consists of flat plates, or $16,000 - 150\frac{l}{b}$, if over consists of a channel section where l = unsupported distance and b = width of flange."

45. Begin with the following sentence, so that the paragraph will read: "The latticing of compression members shall be proportioned to resist the shearing stresses corresponding to the allowance for flexure provided in the column formula in paragraph 16 by the term $70\frac{l}{r}$. The minimum width of lattice bars shall be," etc.

46. Omit marginal heading. Revise so as to read: "Three-fourths-inch rivets shall be used for latticing flanges from 2½ to 3½ in. wide; ⅞-in. rivets shall be used in flanges 3½ in. and over, and lattice bars with at least two rivets shall be used for flanges over 5 in. wide."

51. Change last sentence so as to read: "At least one of these plates shall extend to the far edge of the farthest tie-plate, and the balance to the far edge of the nearest tie-plate, but not less than 6 in. beyond the near edge of the farthest plate."

60. Add "Segmental rollers shall be geared to the upper and lower plates."

61. Omit brackets and the footnote referring thereto.

66. Change "connection angles not less than 7-16 in." to connection angles not less than ½-in. in thickness.

75. Omit brackets and footnote referring thereto.

Substitute the following:

77. "There shall be web stiffeners, generally in pairs, over bearings at points of concentrated loading, and at other points where the thickness of the web is less than 1-60 of the unsupported distance between flange angles. The distance between stiffeners shall not exceed that given by the following formula, with a maximum limit of six feet (and not greater than the clear depth of the web)." [Follow with formula and remainder of paragraph as it now appears in the Manual.]

Substitute the following:

79. "Truss spans shall be given a camber by so proportioning the length of the members that the stringers will be level when the bridge is fully loaded."

80. Omit the footnote, also omit the expression "up to 300 ft. spans" and reconstruct so as to read: "Hip verticals and similar members, and the two end panels of the bottom chords of single-track pin-connected trusses shall be rigid."

84. Marginal heading "Properties."

Phosphorus limit for acid structural steel should be 0.06 instead of 0.08.

Insert the following paragraph after paragraph 84:

84-a. In order that the ultimate strength of full-sized annealed eye-bars may meet the requirements of paragraph 160, the ultimate strength in test specimens may be determined by the manufacturers; all other tests than those for ultimate strength shall conform to the above requirements.

Substitute the following:

91. "Rolled steel shall be tested in the condition in which it comes from the rolls."

Substitute the following:

93. "A deduction of 1 per cent. will be allowed from

*From a report presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association.

the specified percentage for elongation, for each 1/8-in. in thickness above 3/4 in."

111. Add: Material arriving from the mills shall be protected from the weather and shall have clean surfaces before being worked in the shops.

117. Marginal heading Reaming.

Omit last sentence and make additions so that the paragraph will read: "Where sub-punching and reaming are required," etc.

118. Omit the marginal heading, change footnote to correspond with revised addendum and alter so as to read: "When general reaming is required it shall be done after the pieces forming one built member are assembled, and so firmly bolted together that the surfaces shall be in close contact. If necessary to take the pieces apart for shipping and handling, the respective pieces reamed together shall be so marked that they can be reassembled in the same position in the final setting up. No interchange of reamed parts will be permitted."

119. Omit this paragraph, marginal heading and footnote, and substitute: "Reaming shall be done with twist drills and without using any lubricant."

120. Omit marginal heading. Make addition so that the paragraph will read: "The outside burrs on reamed holes shall be removed to the extent of making a 1-16-in. fillet."

126. Substitute the following and change marginal reference to correspond: "The main sections of floor beams and stringers shall be milled to exact length after riveting and the connection angles accurately set flush and true to the milled ends *[or if required by the purchaser the milling shall be done after the connection angles are riveted in place, and milling to extend over the entire face of the member]. The removal of more than 3-32-in. from the thickness of the connection angles will be cause for rejection."

127. Change marginal heading to Riveting and make additions so that the paragraph will read as follows: "Rivets shall be uniformly heated to a light cherry red heat in a gas or oil furnace so constructed that it can be adjusted to the proper temperature. They shall be driven by pressure tools wherever possible. Pneumatic hammers shall be used in preference to hand driving."

129. Change "turn to" in the second line to shall make and make additions so that the paragraph will read: "Wherever bolts are used in place of rivets which transmit shear, the holes shall be reamed parallel and the bolts shall make a driving fit, with the threads entirely outside of the holes. A washer not less than 1/4-in. thick shall be used under nut."

132. Interpolate not less than after "templet" in the second line.

Change marginal reference to correspond with revision in addendum.

140. Make additions so that the paragraph will read: "Steel castings shall be free from large or injurious blow holes and shall be annealed."

142. Make additions so that the paragraph will read: ". . . . The finishing cut of the planing tool shall be fine and correspond with the direction of expansion."

146. Interpolate the word "scale" before "weight."

158. Make addition so that the paragraph will read: "Complete copies of shipping invoices shall be furnished to the purchaser with each shipment. These shall show the scale weights of individual pieces."

Substitute the following:

160. "In eye-bar tests, the minimum ultimate strength shall be 55,000 lbs. per sq. in. The elongation in 10 ft., including fracture, shall be not less than 15 per cent. Bars shall break in the body and the fracture shall be silky or fine granular, and the elastic limit as indicated by the drop of the mercury shall be recorded. Should a bar break in the head and develop the specified elongation, ultimate strength and character of fracture, it shall not be cause for rejection, provided not more than one-third of the total number of bars break in the head (see 133)."

In order to conform to the recommended revisions in the body of the specifications the "Addendum" on page 276 should be changed to the following, and all footnote references given in the specifications should correspond therewith:

Points to Be Specifically Determined by Buyers When Soliciting Proposals for Steel Railroad Bridges.

When general detail drawings are not furnished for the use of bidders specific answers should be given to questions a, b and c, below.

Specific answers should also be given to questions d, e and f if the class of work described in any of the paragraphs there referred to is desired. If these features are not specifically demanded, the unbracketed paragraphs will be construed to define the kind of work desired.

(a) What class of live load shall be used? (Par. 7 and 8.)

(b) Shall linseed oil or paint be used. If paint, what kind? (Par. 148.)

(c) Shall contractor furnish floor bolts?

(d) Shall general reaming be done? (Par. 118.)

(e) Shall field connections be assembled at the shop? (Par. 132.)

(f) Shall floor connection angles be milled after riveting? (Par. 126.)

Page 256. Omit Table of Standard Upsets and substitute the following:

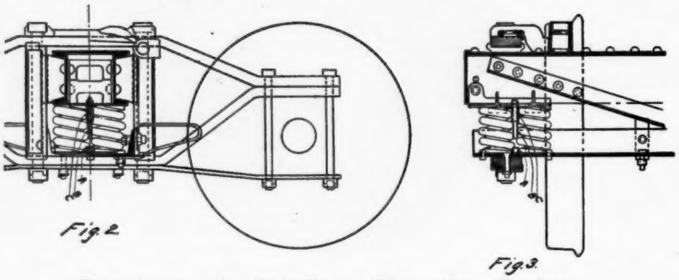
Recommended Conventional Signs.

A—Bridge Rivets.

[The committee presents conventional signs for various kinds of rivets.]

B—Stresses.

+ Tension.
— Compression.



Figs. 2 and 3. Details of Recording Devices.

Conclusions.

The committeee recommends:

(1) That the recommendations under the heading "Revision of Manual" be adopted.

(2) That the report on "Care of Existing Bridges" be adopted and incorporated in the Manual.

(3) That the subject of "Specifications for Erection of Railroad Bridges" be referred back to the committee for further consideration.

(4) That the Review of the Development of Bridge Building in America be accepted.

(5) That report on Reinforced Concrete vs. Steel be accepted.

The report is signed by: J. E. Greiner (consulting engineer), chairman; C. F. Loweth (C., M. & St. P.), vice-chairman; C. H. Cartlidge (C., B. & Q.), C. L. Crandall (Cornell University), B. W. Guppy (B. & M.), A. J. Himes (N. Y., C. & St. L.), Charles M. Mills (Phila. El. R. R. & Sub.), A. D. Page (civil engineer), C. D. Purdon (consulting engineer), C. C. Schneider (consulting engineer), F. E. Turneaure (Univ. of Wis.), and J. R. Worcester (consulting engineer).

Appendix A.

Care of Existing Bridges—Methods of Field Work, Inspection and Records of Inspection.

This compound subject has been under consideration for several years and progress reports for information and discussion have been submitted. It was not the intention that they be included in the Manual.

The committee is of the opinion that the matter which pertains to inspection and records of inspection can be arranged so as to embody instructions of sufficient general application to justify publication in the Manual.

It therefore submits the following final report, with the recommendation that paragraphs (1), (2) and (3) be printed in the Manual.

Inspection of Bridges and Records of Inspection.

Inspections of bridges should be made with the object of discovering weakness or defects, of ascertaining the amount and rate of deterioration, the general physical condition, safety under traffic and the necessity for repairs, reinforcements and renewals.

The frequence of inspections should depend on the character of the bridges, their location, strength and physical condition. A thorough annual inspection by a competent inspector may suffice for many cases where the bridges have been properly constructed and are not overloaded. On the other hand, a daily inspection may be necessary in

order to observe with sufficient promptness damage which may be caused by an accidental blow.

Between these two extremes there are many reasons for making inspections of more or less thoroughness and frequency, but the committee does not feel that a set of hard and fast rules, prescribing in detail the manner and frequency of making inspections, could be drawn up which would be alike efficient for the various conditions of traffic, the many types of structures to be inspected, and the widely differing forms of organization of the forces entrusted with the safety and maintenance of railway bridges.

A proper system of bridge inspection should therefore generally include the following:

(1) Inspection by the regular section forces, daily, or as often as they inspect the track under their supervision. The object of this inspection is to discover any damage to the structure from fire, flood, derailments or other accidents from traffic, or any displacement in the structure in whole or in part. This inspection, due to the lack of skill on the part of the section forces, must necessarily be superficial, and will rarely, if ever, do more than call attention to unsafe conditions arising from causes other than those of natural depreciation. No reports of such inspections need be made unless adverse conditions are discovered.

(2) At periodic intervals of from one to six months there should be inspections by bridge foremen or others experienced in bridge repairs. These inspections should be more thorough than those of the section forces, and are intended to discover all the defects, arising from traffic, to which the bridge is subjected, and those due to natural depreciation or other causes. Reports of such inspections should be made to the one next in authority; preferably to the one most directly or primarily responsible for the safety of the structures.

(3) Annual or semi-annual inspections are to be made by men experienced in the design and maintenance of bridges; preferably by those who are primarily responsible for their safe maintenance. The reports of these inspections should be filed, and in connection with an examination of office data will determine the safety of the structures, and be the basis for decisions as to repairs, reinforcements or renewals.

The inspections outlined in (1), (2) and (3) above must be considered as quite general. Railway bridges are of timber, masonry or metal, and occasionally of unusual design; men competent to inspect one kind are often incompetent to inspect other kinds, and it therefore may be necessary to limit an inspector to structures of a certain kind.

Appendix B.

Reinforced Concrete vs. Steel for Short Span Bridges.

The committee was instructed to report on: "To what extent is steel construction, carrying heavy loads at high speed, preferable to reinforced concrete for main girders of bridges?"

This inquiry is understood to mean a consideration of "The relative desirability of reinforced concrete vs. steel construction for short span bridges," and the committee submits the following as a progress report for information and discussion, with the recommendation that it be referred back for further consideration.

In any bridge the qualities to be desired are: Adequate strength, freedom from vibration and excessive deflection, economy in first cost, economy in maintenance, and permanence.

The theory of flexure of reinforced concrete is sufficiently well understood to enable safe and economical designs to be made of this material, and experience with reinforced concrete structures carrying dead loads only has been abundant. Experience with such structures carrying heavy live loads and subjected to the shock and vibration of these loads, moving at high speed, has not been so extensive, but reinforced concrete girders can be designed and built in short spans of any strength required, or likely to be required, by railway loads. In the event of overloading or defective construction, reinforced concrete will give quite as much warning of probable failure as other materials.

While the art of bridge construction in steel has so far progressed that the safeguards surroundings the manufacture of steel and its fabrication into bridges have come to be matters of course, the equally careful supervision of the manufacture of reinforced concrete seems burdensome to the engineer, although it is just as necessary, but not more so. This necessity for careful inspection of methods and materials of manufacture needs to be emphasized, for, like steel, concrete may most easily be ruined by careless workmen, but when the same pains are taken to produce good concrete as are now taken to produce good steel, with the same rigid inspection and insistence on proper specifications, there will result a product which we believe will prove to be equally reliable.

One of the chief advantages of reinforced concrete over steel for short spans is that the form lends itself more readily to ballast floor construction, the superiority of which to open decks is evident to every operating officer, not only on the account of the absence of wood, which may rot or burn, or exposed steel, which requires protection from brine drippings or other corrosive influences, but also on account of the freedom from vibration and excessive deflection and the reduction of the cost of maintenance to a minimum.

The comparative economy of the two styles of construction is a matter which is not easily determined in general terms, depending as it does upon the market price of steel, concrete materials and labor. The character of the design is also a factor of first importance. Generally speaking, if it is not considered advisable to use ballasted floors in a particular case, for that case the short span of I-beams with ordinary floor of wooden ties is the cheaper construction in first cost. If, however, a large number of similar spans are to be built, so that concrete slabs can be constructed in a central and conveniently arranged plant, and if the erected price of steel work approximates 3 cents a lb., the difference between concrete slab construction built with ballast floor and steel construction with open wooden floor will be small, and in many cases will be favorable to the concrete.

If the designs contemplate the use of I-beams embedded in concrete, compared with reinforced concrete girders, economy will be all on the side of the latter. Short spans

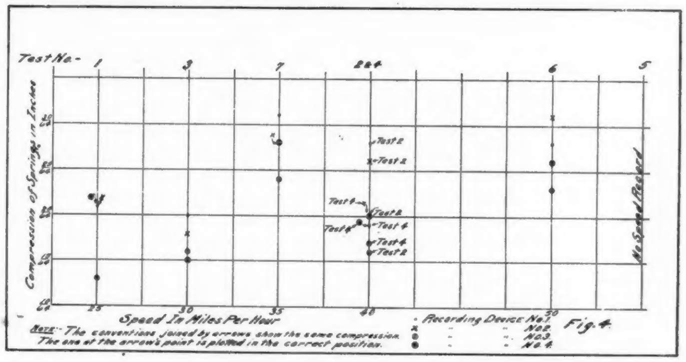


Fig. 4. Results of Tests.

of reinforced concrete also permit a substantial economy in the design of abutments carrying them. It is the opinion of the committee that reinforced concrete flat slabs or girders are not generally advisable for railway loads in spans exceeding 40 ft. But the importance of these small structures is very great, and it believes the use of reinforced concrete for these small spans is desirable.

Length of Flat Spots on Car Wheels.

In submitting its report to the last convention, the sub-committee felt that without an appropriation of funds sufficient to carry on some experimental investigation nothing further of interest or value concerning the effect of flat wheels on the roadway structures could be learned. It was expected, however, that the work of the sub-committee on Impact would develop some information of value, and it is now able to present a statement by that sub-committee concerning the impact of flat wheels on bridges. The sub-committee on Impact gave particular attention to this matter while carrying on some of its impact measurements and has now had sufficient time to review its data. The result of its study is embodied in the "Observations of the Effect of Flat Spots on Car Wheels on Bridge Stresses, made by Sub-Committee on Impact Tests," submitted herewith. These observations indicate a jarring or vibratory effect rather than a material increase in the unit stresses of the several bridge members. Such a result was to be expected, but the possession of tangible evidence of this effect is a material addition to our knowledge of the behavior of bridges.

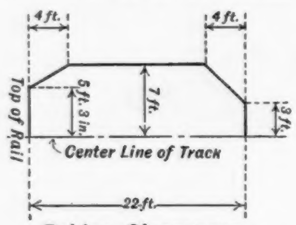
In the general discussion concerning the effect of flat wheels, which has been carried on during the past year or two in the technical journals and various meetings, it

has been asserted that under a rapidly moving train the fall of a car wheel due to a flat spot is so trifling that no serious blow could be delivered. For this reason the sub-committee has sought to procure some evidence of the magnitude of the blow from a flat wheel, and through the courtesy of A. W. Johnston, past-president of the association, and general manager of the New York, Chicago & St. Louis, an attempt has been made to measure the force of the blow under working conditions.

For this purpose an 80,000-lb. capacity car was equipped with registering devices to measure the compression of the car springs and a pair of wheels with flat spots was placed in one of the trucks. A diagram showing the position of the flat wheels, the springs and the recording devices is shown in Fig. 1. The trucks were of the arch bar type and in the center of each nest of springs there was placed a small tube in which was inserted a steel pin fitted sufficiently tight to hold it in place, but capable of being forced upward when, through the deflection of the springs, it came in contact with a projection arranged at the bottom of the nest. This device is shown in Figs. 2 and 3.

Messrs. Blaser and Pallister, of the instructing force of the Case School of Applied Science, calibrated the springs both before and after the test. The observations of the test were made by G. H. Tinker, bridge engineer of the New York, Chicago & St. Louis, assisted by Messrs. Blaser and Pallister.

The car was loaded with splice bars to its full capacity, the load being uniformly distributed. The trucks were fitted with registering devices and the flat wheels placed in position, at the Conneaut shops, The car was then run to Cleveland and the test made on a piece of straight track in excellent condition between Cleveland and Lorain. Test No. 5, however, was a run of several miles over track with



Bridge Clearances.

curves and switches, and is, therefore, not considered here. At the beginning of the test the steel pins were driven down in the tubes until they came in contact with the projection A, Figs. 2 and 3. The train was then run for a short distance, brought to a stop, and, the displacement of the steel pin carefully measured with calipers. After this measurement, the pin was again driven down and the process repeated. In this manner seven different tests were made.

In the following discussion it is assumed that inasmuch as the springs and recording devices are located midway between the two pairs of wheels belonging to a single truck, if the wheels of one pair have flat spots, only half of the influence of those spots is recorded. This may not be precisely correct, but it seems the most reasonable assumption that can be made.

The deflection of the car springs is occasioned by many causes. First in importance is the load of the car. In addition to this every inequality of the track produce a swaying or lurching movement of the car body, which causes the springs to oscillate back and forth. Bad rails, particles of earth and stone on the rails, the starting and stopping of the locomotive, the change of speed of the locomotive, and the application of brakes all cause variations in the deflection of the springs. To avoid these effects as far as possible, the recording device was arranged so that it could be set at any given time and indications secured at any time thereafter, and a very smooth and straight piece of track was selected on which to make the tests. The speed record was secured by counting the joints as the train passed over them. The wheels having flat spots were placed in a lathe and found to be elsewhere perfectly circular and truly centered on the axles.

The readings taken in the calibration of the springs were plotted and connected by continuous lines, which proved to be parallel within the limits of the test. This means that a given change of deflection indicates a certain number of pounds regardless of which nest of springs is considered and regardless of whether the calibration was made before or after the test. This is important, since we have to consider the differences of deflection rather than the total load. From these curves it was found that a load of 32,500 lbs. applied to a nest of four springs produced a compression of one inch.

The values of all of the observed deflections in pounds, platted in Fig. 4, with speeds as abscissas and deflections in inches as ordinates. It should be remembered that these are not total deflections, but deflections caused by the motion of the car between the points of starting and stopping. The deflections shown for the truck with true wheels are therefore due entirely to the ordinary causes producing an oscillation of the springs. In the truck where the flat wheels were located the flat spots were an additional cause of oscillation. It is assumed that any difference between the deflections in the truck with true wheels and in the truck in which the flat wheels were placed was due to the flat spots.

It is believed that recording devices Nos. 1 and 4 did not show accurately the true deflections, but that those on the other side of the car, Nos. 2 and 3, did. The pressure recorded by device No. 2 compared with that recorded by device No. 3 and arranged as in the following table, shows the increase of pressure on the rail due to the flat spot as given in the sixth column:

Test.	Speed, Miles per Hour.	Compression Shown by Device No. 2, Pounds.	Compression Shown by Device No. 3, Pounds.	Difference.	Increase of Pressure on Rail Due to Flat Spot.
1	25	10,800	6,700	4,100	8,200
2	40	13,300	8,000	5,300	10,600
3	30	9,000	8,000	1,000	2,000
4	40	10,000	8,700	1,300	2,600
5	..	14,300	15,800	1,500	3,000
6	50	15,800	11,600	4,200	8,400
7	35	14,300	12,100	2,100	4,200

It is apparent that the increase of pressure on the rail due to a flat spot under the conditions of the test may amount to as much as 10,600 lbs.

The pressure shown in the table is of course the number of pounds pressure required to compress the spring the amounts mentioned in the tests. But it should be remembered that the impacts producing these deflections were made almost instantaneously and the effect is that of a blow and not a gradually applied load. This difference is very important since the steel of which rails are made is injuriously affected by blows.

The tests appear to be a sufficient demonstration that a flat wheel does actually deliver a very serious blow on the rail, and in conclusion we would say that while these tests may not be sufficient to change the opinions of those who hold that the present M. C. B. limit for flat spots of 2½ in. is sufficient for 100,000-lb. capacity cars, they certainly indicate an abuse of the track structure which is hard to excuse and which is of such serious moment as to demand the attention of this association.

Observations on Effect of Flat Car Wheels on Bridge Stresses Made by Sub-Committee on Impact Tests.

During the progress of the special impact tests the Sub-Committee on Impact made such observations as it could relative to the effect of flat spots on car wheels on the stresses in bridges. In one series of tests a car having a wheel with a very decided flat spot was purposely used, and in other tests wheels with flat spots were occasionally noted in the test trains. In one case the tires of the locomotive were badly worn and quite rough.

From these observations the committee is unable to report any quantitative results. A distinct effect was noticeable on such members as stringers and floor beams. Where the track was smooth, and the wheels also, the record from the instruments attached to such members was generally clear and readable, even though the stresses under high speed might be largely in excess of those at low speed. In the case, however, of a rough track, caused by an open rail joint, or a flat or rough wheel, the passing train would produce such a "jarring" action on the stringer or beam that the measuring apparatus would be so shaken as to cause the parts to vibrate excessively, producing large and rapid vibrations in the record, thus rendering the diagram unreliable and, in many cases, quite worthless. Such diagrams would also commonly result where, for any reason, there was little or no elasticity between the rail and the beam. In one case where the rails were placed in steel troughs riveted directly to small cross-beams, the hip verticals were affected in this way. This effect would, however, seldom reach beyond the floor beams, and in the case of widely spaced stringers, would not always show up in the stringers. It would seem, therefore, that the "jar-

ring" effect might not imply a very great increase in stress, but that there is some increase is undoubtedly true.

The effect of flat spots on main truss members of a bridge was not definitely noticed in any case, but there were several cases where a train of three or four heavily loaded freight cars in a test train caused vibrations of the whole structure quite as large, relatively to the static deflection, as those caused by the locomotive. This effect was not noted in connection with any decided flat spots in the wheels, but in some cases at least, it seemed to be caused by a vibratory motion of a car body, due to some cause. This vibratory motion appeared to be due rather to some eccentricity of the bearing or of the wheel than to any flat spots, although our observations were not extensive enough to enable us to make a definite statement on this point. The speed at which such truss vibrations occurred under the loaded freight cars was generally high, such as 50 to 60 miles per hour. No such vibrations were ever noticed under the cars of a passenger train. The difference in equipment was very evident in the character of the diagrams produced.

CONSERVATION.*

The committee has been in correspondence with Gifford Pinchot, chairman of the Joint Committee on Conservation, and with his former and present assistants, Mr. Shipp and Mr. Gipe.

On May 13, 1909, the secretary of the Joint Committee on Conservation submitted a report containing suggestions as to the method by which the railway companies could assist in the conservation of natural resources. These suggestions, with some slight modifications, are submitted herewith, without comment.

The committee will continue to keep in touch with the Joint Committee on Conservation, and will hold itself in readiness to co-operate with that committee when called upon to do so, and will keep the association posted as to any steps that are taken by the Joint Committee on Conservation relating to railways.

The report is signed by: A. S. Baldwin (Ill. Cent.), chairman; Moses Burpee (Bang. & Aroos.), W. A. Bostwick (Carnegie Steel Co.), E. B. Cushing (Sunset Central Lines), E. O. Faulkner (A., T. & S. F.), A. L. Kuehn (Amer. Creosoting Works), D. W. Lum (Southern), and C. L. Ransom (C. & N. W.).

Appendix.

Suggestions for Railway Work in Forest Conservation.

Control of Forest Fires.

No accurate data has ever been compiled upon the total forest fire losses in the United States. More than 1,200,000 acres of forest were burned over last year in Wisconsin, and standing timber valued at nearly $3,000,000 was destroyed. In West Virginia, 1,700,000 acres were burned over, with about the same loss as in Wisconsin, while in Michigan it is estimated that 7,000,000 acres were burned over, and that $10,000,000 worth of timber was destroyed. These estimates do not include damage to young growth nor to the forest soil, which is often more serious than the damage to mature timber.

Railways may assist in the work of forest preservation on the following general lines:

(a) Keeping the right-of-way cleared of all inflammable material.

(b) The exercise of great care to prevent the escape of fire while this clearing is being done.

(c) Having it thoroughly understood by all section foremen that they and their crews must immediately go to and put out fires, set by the railway, about which information reaches them. Most roads have standing orders of this sort, but they are sometimes disregarded.

(d) By holding each train crew responsible for reporting to the section foreman, both by whistle signals and by personal report, any fires passed.

It is recommended that this association do all in its power:

(1) To obtain systematic co-operation of railways with federal and state authorities in the abatement of forest fires, whether originating from locomotives or from other causes.

(2) To devise efficient spark arresters.

(3) To enforce proper stoking.

(4) To place on the operatives, especially section foremen, responsibility for keeping rights-of-way clear and combating fires which do start.

Growing Timber for Railway Purposes.

A number of railways have adopted the policy of owning and managing their own forests. Some have withdrawn from the market the remainder of their forested land-grant areas; others have purchased forest land outright. The management of existing forests is more economical, and in the long run will probably be more satisfactory than the establishment of plantations. Such lands should be in charge of trained foresters.

Some roads operate in regions where lands already forested cannot be purchased. Almost every railway, however, can utilize waste lands, such as often become its property through the purchase of rights-of-way, for forest plantations. These plantations, again, should be installed and managed by trained men. The following general rules for plantations may be of assistance:

Rapid-growing species should be planted, as a rule, and the ties and timbers therefrom given preservative treatment. The harder and more durable woods are, as a rule, very slow growing, and plantations of these species would be less profitable. Loblolly pine in the south Atlantic and Gulf states; red oak, Scotch pine and European larch for the central and northeastern states; red or Norway pine for the northern lake states; Douglas fir for the northern Pacific coast; eucalyptus for southern California and other regions where there is no frost, are recommended. Black locust, which reaches fence post and tie size quickly, is also desirable wherever the locust borer is not dangerous. The planting of chestnut is not recommended anywhere until means of combating the chestnut bark diseases have been found. The species to be planted must always be suitable for the immediate locality.

Use of Sawed Instead of Hewed Ties.

About 70 per cent of the tree is wasted in making hewed ties. The waste is due to excess of material contained in most ties as hewed, loss of wood due to hewing large logs, the failure of tie cutters to use the butts of trees, on account of extra work involved, and to their failure to cut as far into the tops as could be done, through fear of making cull ties.

The saving in lumber by sawing, instead of hewing, ties varies from 20 to 190 per cent of the volume of wood actually going into the hewed ties, depending mainly on the size of the log. From a 16-foot log of loblolly pine, with a diameter at the small end inside the bark of 15 inches, two hewed ties can be obtained which need not contain more than 64 board feet under the usual specifications. By sawing the same log, four ties can be obtained, and also 57 board feet of lumber, or a total of 185 board feet. The gain in the form of ties and boards in this instance is nearly 190 per cent. This case is extreme, but it is safe to put the average gain from sawing at 80 per cent.

In 1907, 118,384,000 hewed ties were made—77 per cent of the total number used. Assuming that they contained, on the average, three cubic feet, and that the waste due to hewing was 80 per cent, the loss was 284,100,000 cubic feet, which is equivalent to the annual growth of merchantable wood on 9,470,000 acres of well-stocked timber land. In hewing ties, trees 12 to 15 inches in diameter are preferred. This is the size when the most rapid growth is being made, and when the trees should be left in the forest to accumulate wood. When ties are sawed, the larger the tree the better the quality of the tie and the less the cost of manufacture.

The chief objections to the sawed tie are that it is weaker and less durable than the hewed tie. On these points it may be said that few ties break that do not first partially decay, and preservative treatment will largely prevent decay.

The Forest Service found that the sale of lodgepole pine brought greater returns for trees under 15 inches when sold for hewed ties (scaling each tie 6 in. x 8 in. x 8 ft. at 33⅓ board feet) than when sold in the log by the Scribner decimal scale.

This does not show that hewing gives a greater product than sawing, but that the method of scaling saw logs in wide use robs the owner of small timber to such an extent that he gets larger returns by selling hewed ties, even though waste is greater.

For 9, 10 and 11-inch trees, hewing ties is about as eco-

*From the report of the special committee, co-operating with the National Conservation Commission, presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association.

nomical as sawing, and when it is desirable to cut such trees, as in thinning dense stands, or for species like lodgepole and Jack pines, whose rate of growth falls off beyond that point, tie hewing can well be employed.

In small timber tracts or woodlots, where it will not pay to erect a mill, tie hewing may be desirable.

To summarize, then, tie hewing cannot be condemned without exception.

(1) Hewing is economical for very small trees when these are desirable to cut from the point of growth.

(2) Hewing ties from trees under 15 to 18 inches and getting full scale is more desirable for the stumpage owner than being robbed by the scale of most existing log rules, if the price per thousand feet is the same.

(3) Hewing ties is desirable in small woodlots where a mill would be impracticable.

(4) Sawing ties is more economical by 20 to 200 per cent, and preferable for trees over 11 inches, when the mill man owns the stumpage, or for the independent stumpage owner when he is paid for the full saw output of his logs.

Supply of Creosote.

The greatest obstacle confronting the rapid advancement of preservative treatment is the lack of an adequate supply of a suitable preservative material to be obtained at a reasonable cost. Considerable difficulty has been experienced in securing a sufficient quantity of good grades of creosote. The consumption of domestic creosote in 1908 was over 17,000,000 gallons, and that of foreign creosote nearly 39,000,000 gallons.

The production and composition of domestic creosote are regulated to a large extent by the demand for pitch, which is the primary product for which coal tar is distilled. Creosote is a by-product of insufficient value in itself to pay the cost of manufacture. The pitch takes out a large proportion of the heavier constituents of the tar and leaves a proportionately increased amount of light oils.

In Europe, the conditions are quite the reverse. There is little demand for pitch, but a large demand for the lighter constituents of the tar, which are used in the manufacture of the aniline dyes. Hence, the lighter constituents are removed and the heavier left in the creosote. In the United States these heavier constituents are considered the most valuable components of the preservative, and consequently at the same price the foreign oils are preferred.

Coal tar is obtained chiefly from the distillation of coal in by-product ovens. Among the advantages of the by-product over the more common bee-hive oven are the possibility of using coals of greater range of volatility, larger capacity of oven, shorter time of operation, larger product of coke, and, what is especially important here, the using of the by-products.

The by-product oven, however, costs over four times as much as the bee-hive oven, and requires skilled labor to operate. Moreover, in the past the market for the by-products has been uncertain.

Coal tar is also obtained as a by-product in the manufacture of illuminating gas. According to the report of the United States Geological Survey, in 1902, there were 1,663 by-product retort ovens; in 1907 there were 3,892. Much gas is now made from petroleum instead of coal. In 1907 the production of oil and water gas was practically twice that of coal gas.

It is common practice in this country to mix the tars derived from oil and coal. Inasmuch as the efficiency of oil tar creosote has never been thoroughly tested as a wood preservative, this practice has caused a strong prejudice against the domestic article. It cannot be stated with certainty at this time whether this prejudice is wholly warranted, but indications are that it is.

It is recommended:

(1) That efforts be made to secure such improvements and economies in the construction and operation of by-product coke ovens as will lead to their general substitution for the bee-hive type.

(2) That tests be made to determine the relative efficiency of oil tar creosote and coal tar creosote as preservatives of wood.

(3) That tests be made to determine the minimum quantity of oil of a specified grade necessary to preserve wood under given conditions.

(4) That tests be made to find satisfactory substitutes for creosote in the treatment of timber.

RAIL.*

The board of direction instructed the committee as follows:

(1) Consider revision of Manual; if no changes are recommended, make statement accordingly.

(2) Continue the investigation of the breakage and failure of rails and present summary of conclusions drawn from reports received.

(3) Report on the results obtained from the use of open-hearth and special alloy rails, and chemical composition of such rails.

(4) Present report showing diagrams or photographs of typical characteristic rail failures corresponding to the adopted classification of rail failures.

(5) Report on any recommended changes in specifications for steel rails heretofore adopted, and prepare specifications for open-hearth rails.

(6) Present recommendations on standard rail sections.

(7) Consider the rail joint question and recommend design and specifications.

(8) Reconsider and report any recommended change in standard drilling for rails as given in the Manual.

The committee also considers as a part of its instructions a resolution submitted by the committee on Rail and Wheel Sections to the American Railway Association, and adopted by that association at the meeting held in New York April 22, 1908, to the effect that sections A and B, and the specifications for open-hearth and Bessemer rails be referred to the American Railway Engineering and Maintenance of Way Association, with the request that they follow up the question of determining the details as to drop test, etc., by observing the actual results of rails rolled under the new sections, tabulate all information as to comparative wear of rails rolled from the different parts of the ingot, and all other information necessary, keep careful record of the comparative results in service of rails of types A and B, and prepare and submit to the American Railway Association a single type of section which will embody their ideas as to the best type.

The work was sub-divided as follows:

Sub-Committee A—Experiments and Tests.

(a) Confer with the Manufacturers' Committee, through its chairman, F. W. Wood, from time to time, in order to keep each committee posted. It is of the greatest importance that we should not lose the harmonious feeling which has been established by the American Railway Association between the railway men and the manufacturers.

(b) Report on the results of drop tests.

(c) Recommend additional methods of testing rail.

(d) Exchange statistical information with the committee of the Manufacturers' Association, and under instructions from the general committee, confer with kindred associations.

(e) Make such tests as may be deemed advisable by the general committee; investigate and report upon tests made by outside parties, such as the Watertown Arsenal, when available, and examine into and report upon methods of manufacture and handling of rails at the mills.

Members: J. A. Atwood, chairman; R. Montfort, F. A. Delano, P. H. Dudley, J. D. Isaacs, Thomas H. Johnson, J. P. Snow, A. W. Thompson.

Sub-Committee B—Sections and Specifications.

(a) Consider revision of Manual; if no changes are recommended, make statement accordingly.

(b) Report on any recommended changes in specifications for steel rails heretofore adopted, and prepare specifications for open-hearth rails.

(c) Present recommendation on standard rail sections.

(d) Consider the rail joint question and recommend design and specifications.

(e) Reconsider and report any recommended changes in standard drilling for rails as given in the Manual.

Members: J. B. Berry, chairman; M. L. Byers, J. W. Kendrick, George W. Kittredge, Joseph T. Richards, Robert Trimble.

Sub-Committee C—Rail Service.

(a) Continue the investigation of the breakage and failure of rails and present summary of conclusions drawn from reports received.

(b) Report on the results obtained from the use of open-hearth and special alloy rails, and chemical composition of such rails.

(c) Present report showing diagrams or photographs of

*From a report presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association.

typical characteristic rail failures corresponding to the adopted classifications of rail failures.

(d) Make comparative statement of the results of the use of series A and B, and other sections of rail.

Members: W. C. Cushing, chairman; E. B. Ashby, A. S. Baldwin, C. H. Ewing, H. G. Kelley, D. W. Lum.

Statistics of Rail Failures.

The first rail failure statistics for the six-months period from April 30 to October 31, 1908, have been printed in Bulletin No. 111; the statistics for the six months from October 31, 1908, to April 30, 1909, have been printed in Bulletin No. 116.

Open-Hearth and Special Alloy Steel Rails.

The information obtained for the six-months period from April 30 to October 31, 1908, has been printed in Bulletin No. 111. In the same bulletin A. W. Thompson, chief engineer of maintenance of way of the Baltimore & Ohio, has given the results of the use of titanium rail by that company. In Bulletin No. 116 the information of the comparative wear of special rail has been given for the period of six months from October 31, 1908, to April 30, 1909.

Characteristic Rail Failures.

The information obtained relative to this subject has been printed in Bulletin No. 116.

Specifications.

A new specification should not be proposed at this time without careful consideration. So far as we know, no company has purchased rails under the specifications approved by the American Railway Association and referred to us; nor do we know of any company that has succeeded in buying rails during the past two years according to a specification entirely satisfactory to the company. We believe that all of the specifications under which rails have been rolled have been compromises on the part of both parties, with the general result that neither party is entirely satisfied. Our experience during the year has brought to our attention some defects in all of the specifications now before us, and acting under the impression that there is a distinct feeling that we should revise our specifications, we offer the attached specifications for your consideration. Our association has no specification for open-hearth rails, and a specification for open-hearth rails is included.

We believe it necessary to submit a sliding scale for the percentages of carbon and phosphorus, which provides for increasing the carbon as the phosphorus decreases. The fixing of this scale properly is a matter requiring care and we admit that our knowledge on the subject is limited. The American Railway Association specification says: "When lower phosphorus can be secured a proper proportionate increase in carbon should be made." The amount of increase is not provided for in the specifications and this appears to us to be necessary in order to secure uniformity of practice. Bessemer rails are being furnished regularly with phosphorus under the maximum allowed, and where this is done, the carbon should be raised above the higher limit now fixed in our specifications, or a soft and poor wearing rail will result; yet this condition has not been fully guarded against in rails furnished under existing specifications. The lower and upper limits for carbon have heretofore been fixed with the intention that the mills furnish rails with a composition as near between the two limits as possible. The mills, however, in order to meet the prescribed drop tests with the least difficulty, keep both the carbon and manganese as nearly as possible to the lower limits, with the corresponding result that a generally poor-wearing rail is furnished.

Some roads have prescribed the limits of deflection to be allowed under the drop tests. With our present knowledge, we believe that we should fix a minimum deflection to eliminate brittle rails and to secure greater uniformity of product; also maximum deflection to eliminate soft rails. We are not able at the present time to fix these limits, but our ultimate object will be to determine and fix such limits for the specifications.

With reference to the amount of discard, time of holding in ladle, size of nozzles and such other details of manufacture or machinery, we are of the opinion that the physical and chemical tests required should be prescribed and that we should see that the material submitted for acceptance meets the prescribed tests. We should not dictate to the manufacturers the amount of crop which shall be removed from the top of the ingot, as this should vary with the care and time consumed at the various mills. The railways should not be asked to take anything but sound material in their rails. The mills can furnish such sound material if the proper care and sufficient time are taken in the making of the ingots. Information derived from the tests being made at the Watertown Arsenal shows definitely that sound rails cannot be made from unsound ingots, and that, therefore, the prime requisite in securing a sound rail is to first secure the sound ingot.

We recommend that the present specifications for steel rails be withdrawn from the Manual as no longer representing the current state of the art.

We submit herewith as an appendix a form for specifications. It will have to be amended from time to time as we receive further information on the subject.

Standard Rail Section.

Owing to the conditions existing in 1908 very little rail was laid, and practically none of the A. R. A. sections in such manner as to give the needed information. This year several roads have laid A. R. A. sections of rail. These rails have been in the track so short a time that we are not justified in drawing any conclusions as to which of the A. R. A. types is the better, or if either is better than the A.S.C.E. sections.

The statistics for rail failures given in Bulletin No. 116 show that the difference in section can be entirely annihilated by difference in chemical composition and by the treatment in furnace and mill.

The results so far obtained from the heavy base A. R. A. sections are disappointing, as we have received from the mills some rail of the new section which was as bad as we received with the old A.S.C.E. section.

The tests to be inaugurated by the committee, combined with the results of the tests at Watertown and the performance of the rail in the track, will give us valuable data to aid us in coming to a final conclusion.

The small demand, as indicated by mill sales data, and the slight possible variation in section of rail below 75 lbs. weight per yard makes inadvisable the consideration of new sections for this light-weight rail.

No recommendation as to sections of 75 lbs. and over is made at this time because of the lack of undisputed data upon which to base such design, the service value of the rail unquestionably being dependent upon chemical composition, furnace practice and mill practice, as well as upon the detail differences of dimensions, and the exact effect of each of these various factors is largely in doubt.

Rail Joints.

The tests at Watertown have not progressed as far as we would wish. It is deemed advisable to await these results before submitting recommendations on this subject. The committee will compile the information received from the Watertown tests and publish a special bulletin with the information at hand.

Standard Drilling.

(See Manual, Page 65.)

We are not ready to recommend any changes, although we are of the opinion that it is desirable to make a change. The tests now being made on joints at the Watertown Arsenal should give some information to aid us in fixing a proper drilling. The drilling now adopted as standard and incorporated in the Manual causes interference in the six-hole angle bars between bolts and spikes where slotted holes for spikes are used. We would recommend that railway companies which have not adopted the standard drilling postpone action for another year.

Tests.

The committee is arranging for a series of tests on rails of different sections and weights of both Bessemer and open-hearth steel, manufactured by different mills, with a uniform chemical composition for each kind of rail. The tests are to embrace drop tests, tests on revolving machine at Steelton, tests on reciprocating machine at Sparrows Point and a service test in track, the work to be done under the supervision of a man working under the committee.

Drop Testing Machine Specifications.

Changes in the specifications as now printed in the Proceedings are recommended in the conclusions presented below:

Conclusions.

The committee presents the following conclusions:

(1) That the specifications and plan for drop testing machine, approved by the association, be revised as follows:

Paragraph 2: Eliminate the last sentence and substitute the following: "Anvil to be guided in its vertical movement by removable finished wearing strips, these wearing

strips to be suitably attached to the finished edges of the column base."

Paragraph 5: Insert the following after the word "castings" in the first sentence: "And the surface of the anvil between these pedestals shall be formed to receive a wooden block to absorb shock under broken test pieces."

Paragraph 6: In the first sentence substitute the words "column base" for "base plate."

(2) That the specifications and plan for drop testing machine, as revised above, be printed in the Manual of Recommended Practice.

(3) That the present specifications for steel rails be withdrawn from the Manual of Recommended Practice of the association as no longer representing the current state of the art.

(4) That the specifications for Bessemer and open-hearth rails, as recommended above, be printed in the Proceedings, and that a note be added to the effect that these specifications are intended for a guide in the preparations of future specifications, and it is recommended that all railways embody in their specifications such matter from the specifications herewith presented as in their judgment is necessary to secure better results from the mills.

(5) That rail failure statistics be collected for tabulation and analysis from railway companies for the period of one year ending October 31, instead of for a period of six months, and that the title of form M. W. 2004-A be changed to read "Summary of Steel Rail Failures for One Year, Compared with the Same Period of Previous Year."

The report is signed by: Charles S. Churchill (N. & W.), Chairman; R. Montfort (L. & N.), Vice-Chairman; Robert Trimble (Penna. Lines), E. B. Ashby (Lehigh Valley), J. A. Atwood (P. & L. E.), A. S. Baldwin (Ill. Cent.), J. B. Berry (C., R. I. & P.), M. L. Byers (Mo. Pac.), W. C. Cushing (Penna. Lines), F. A. Delano (Wabash), Dr. P. H. Dudley (N. Y. Cent.), C. H. Ewing (P. & R.), John D. Isaacs (Harriman Lines), Thomas H. Johnson (Penna. Lines), Howard G. Kelley (Grand Trunk), J. W. Kendrick (A., T. & S. F.), George W. Kittredge (N. Y. Cent.), D. W. Lum (Southern), Joseph T. Richards (Penna. R. R.), J. P. Snow (B. & M.) and A. W. Thompson (B. & O.).

Appendix.

The American Railway Association.

The American Railway Engineering and Maintenance of Way Association.

Specifications for Steel Rails.

1. The entire process of manufacture shall be in accordance with the best current state of the art.

(a) Ingots shall be kept in a vertical position until ready to be rolled, or until the metal in the interior has had time to solidify.

(b) Bled ingots shall not be used.

2. The chemical composition of the steel from which the rails are rolled shall be within the following limits:

	Bessemer.		Open-Hearth.	
	80 Lbs. and Under.	85 to 100 Lbs. Inclusive.	80 Lbs. and Under.	85 to 100 Lbs. Inclusive.
Carbon	0.40 to 0.50	0.45 to 0.55	0.53 to 0.66	0.63 to 0.76
Manganese	0.80 to 1.10	0.85 to 1.15	0.75 to 1.00	0.75 to 1.00
Silicon	0.10 to 0.20	0.10 to 0.20	0.10 to 0.20	0.10 to 0.20
Phosphorus not to exceed..........	0.10	0.10	0.04	0.04
Sulphur not to exceed.............	0.075	0.075	0.06	0.06

3. When lower phosphorus can be secured in Bessemer or open-hearth steel, the carbon shall be increased at the rate of 0.035 for each 0.01 reduction in phosphorus.

The percentages of carbon, manganese and silicon in an entire order of rails shall average as high as the mean percentages between the upper and lower limits.

4. There shall be sheared from the end of the bloom formed from the top of the ingot sufficient discard to insure sound rails. All metal from the top of the ingot, whether cut from the bloom or the rail, is the top discard.

5. The number of passes and speed of train shall be so regulated that, on leaving the rolls at the final pass, the temperature of the rails will not exceed that which requires a shrinkage allowance at the hot saws, for a 33-ft. rail of 100 lbs. section, of 6½ in., and ⅛ in. less for each ten pounds decrease of section, these allowances to be decreased at the rate of 1-100 in. for each second of time elapsed between the rail leaving the finishing rolls and being sawed. The bars shall not be held for the purpose of reducing their temperature, nor shall any artificial means of cooling them be used between the leading and finishing passes, nor after they leave the finishing pass.

6. The section of rail shall conform as accurately as possible to the templet furnished by the railroad company. A variation in height of 1-64 in. less or 1-32 in. greater than the specified height, and 1-16 in. in width of flange, will be permitted; but no variations shall be allowed in the dimensions affecting the fit of splice bars.

7. The weight of the rail shall be maintained as nearly as possible, after complying with the preceding paragraph, to that specified in the contract.

A variation of one-half of one per cent. from the calculated weight of section, as applied to an entire order, will be allowed.

Rails will be accepted and paid for according to actual weight.

8. The standard length of rail shall be 33 ft. Ten per cent. of the entire order will be accepted in shorter lengths varying as follows: 30 ft., 28 ft. and 26 ft. A variation of ¼ in. from the specified length will be allowed.

All No. 1 rails less than 33 ft. shall be painted green on both ends.

9. Care should be taken in hot-straightening rails, and it shall result in their being left in such condition that they will not vary throughout their entire length more than four (4) in. from a straight line in any direction when delivered to the cold-straightening presses. Those which vary beyond that amount, or have short kinks, shall be classed as second quality rails, and be so marked. The distance between supports of rails in the straightening press shall not be less than forty-two (42) in.; supports to have flat surfaces and out of wind. Rails shall be straight in line and surface and smooth on head when finished, final straightening being done while cold. They shall be sawed square at ends, variations to be not more than 1-32 in., and prior to shipment shall have the burr caused by the saw cutting removed and the ends made clean.

10. Circular holes for joint bolts shall be drilled in accordance with specifications of the purchaser. They shall in every respect conform accurately to drawing and dimensions furnished and shall be free from burrs.

11. The name of the maker, the weight of the rail and the month and year of manufacture shall be rolled in raised letters and figures on the side of the web. The number of the heat and a letter indicating the portion of the ingot from which the rail was made shall be plainly stamped on the web of each rail, where it will not be covered by the splice bars. Rails to be lettered consecutively A, B, C, etc., the rail from the top of the ingot being A. In case of a top discard of twenty or more per cent. the letter A will be omitted. Open-hearth rails to be branded "O. H."

12. Drop tests shall be made on pieces of rail rolled from the top of the ingot, not less than four (4) ft. and not more than six (6) ft. long, from each heat of steel. These test pieces shall be cut from the rail bar next to either end of the top rail, as selected by the inspector.

The temperature of the test piece shall be between forty (40) and one hundred (100) degrees Fahrenheit.

The test pieces shall be placed head upward on solid supports, five (5) in. top radius, three (3) ft. between centers, and subjected to impact tests, the tup falling free from the following heights:

60 and 70 lb. rail........................16 ft.
80, 85 and 90 lb. rail.....................18 ft.
100 lb. rail...............................20 ft.

The test pieces which do not break under the first drop shall be nicked and tested to destruction.

13. It is proposed to prescribe, under this head, the requirements in regard to deflection, fixing maximum and minimum limits, as soon as proper deflection limits have been decided on.

(a) Two pieces shall be tested from each heat of steel. If either of these test pieces breaks, a third piece shall be tested. If two of the test pieces break without showing physical defects, all rails of the heat will be rejected absolutely. If two of the test pieces do not break, all rails of the heat will be accepted as No. 1 or No. 2 classification, according as the deflection is less or more, respectively, than the prescribed limit.*

(b) If, however, any test piece broken under test "A" shows physical defect, the top rail from each ingot of that heat shall be rejected.

(c) Additional tests shall then be made of test pieces selected by the inspector from the top end of any second rails of the same heat. If two out of three of these second test pieces break, the remainder of the rails of the heat will also be rejected. If two out of three of these second test pieces do not break, the remainder of the rails of the

heat will be accepted, provided they conform to the other requirements of these specifications, as No. 1 or No. 2 classification, according as the deflection is less or more, respectively, than the prescribed limit.*

(d) If any test piece, test "A," does not break, but when nicked and tested to destruction shows interior defect, the top rails from each ingot of that heat shall be rejected.

14. The drop-testing machine shall be the standard of the American Railway Engineering and Maintenance of Way Association, and have a tup of 2,000 lbs. weight, the striking face of which shall have a radius of five (5) in.

The anvil block shall be adequately supported and shall weigh 20,000 lbs.

The supports shall be free from injurious defects and flaws of all kinds.

The supports shall be a part of or firmly secured to the anvil.

15. No. 1 rails shall be free from injurious defects and flaws of all kinds.

16. Rails which, by reason of surface imperfections, are not accepted as No. 1 rails, will be classed as No. 2 rails, but rails which, in the judgment of the inspector, contain physical defects which impair their strength, shall be rejected.

No. 2 rails to the extent of five (5) per cent of the whole order will be received. All rails accepted as No. 2 rails must have the ends painted white, and shall have two prick punch marks on the side of the web near the heat number near the end of the rail, so placed as not to be covered by the splice bars.

Rails improperly drilled or straightened, or from which the burs have not been properly removed, shall be rejected, but may be accepted after being properly finished.

All classes of rails must be kept separate from each other and shipped in separate cars.

All rails must be loaded in the presence of the inspector.

17. (a) Inspectors representing the purchaser shall have free entry to the works of the manufacturer at all times while the contract is being executed, and shall have all reasonable facilities afforded them by the manufacturer to satisfy them that the rails have been made in accordance with the terms of the specifications.

(b) For Bessemer steel the manufacturer shall, before the rails are shipped, furnish the inspector daily with carbon determinations for each heat, and two complete chemical analyses every twenty-four hours representing the average of the other elements contained in the steel, for each day and night turn. These analyses shall be made on drillings taken from small test ingots. The drillings for analyses shall be taken from the ladle test ingot at a distance of ¼ in. beneath the surface.

For open-hearth steel the makers shall furnish the inspectors with the complete chemical analysis for each melt.

(c) On request of the inspector, the manufacturer shall furnish a portion of the test ingot for check analysis.

(d) All tests and inspections shall be made at the place of manufacture, prior to shipment, and shall be so conducted as not to unnecessarily interfere with the operation of the mill.

(e) Rails to be accepted must meet all of the requirements of the specifications.

It is reported that one of the delicacies to be served at the banquet to-night will be frogs' legs. A large supply of manganese frogs has been impounded by the Indianapolis Switch & Frog Company; the Ramapo Iron Works will furnish manganese hard center frogs; and the Pennsylvania Steel Company has a large assortment of anvil face frogs, assuring a variety sufficient to please every taste.

One of the members of The Daily staff, as he kissed his wife goodby Sunday evening, remarked that he would come back somewhere about the last of the week. A careful canvass indicates a similar experience and foresight on the part of the rest of the staff, except that in some instances there appears to have been no one sufficiently interested in any possible return at any possible time to prompt the remark nor a similar inducement to get back soon.

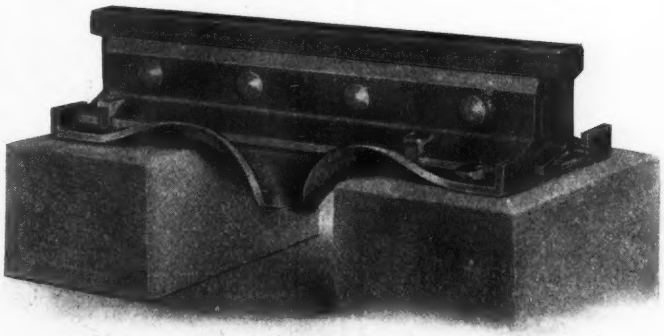
*Note: This clause to be added when the deflection limits are specified.

ABBOTT RAIL JOINT PLATE.

This joint plate is designed to strengthen and improve the efficiency of the ordinary angle bar joint. It is made in one piece, from a flat plate ⅜ in. x 7-16 in. thick, the width and length being made to suit the rail and angle bar with which it is used.

The downturned flanges at the center have a depth of 3 in. and a horizontal lower edge 2 in. wide. The upturned flanges extend from each end of the lower horizontal edge back toward the end of the plate 9½ in. each way from the center, making a total length of flanging of 19 in. The greatest depth of vertical metal is at the center, the point which is subject to the greatest strain. The depth of vertical metal in the upturned flanges is zero at the maximum depth of downturned flanges and is maximum at the zero line of the downturned flanges, finally reaching the other zero limit near the center of the tie, 9½ in. from the cross center line of the plate.

The combination of reversed flanging provides for the stresses in the plate, carrying the strain in a manner similar to that in the component parts of a bridge, and in reality forming a short deck bridge between the two joint ties.



Angle Bars.

There is also a slight camber at the center of the plate to insure the rails first taking bearing at the ends, thus bringing the plate into action before any deflection takes place in the splice bars. The end, or corner, lugs serve as anti-creepers and as guides to the rails holding them in line in case of loosening of the splice bars.

The illustration shows the application of the joint plates. Spike holes are punched to match the slotting in the angle bars and thereby made to fit joints on either side of the track, saving the trouble of distributing in pairs. Auxiliary spike holes are made in diagonally opposite corners for the purpose of spiking the plate without having these spikes come in contact with the rail or angle bar. They cannot be disturbed by vertical wave motion of the rail. The hook part of the spike head is turned away from the angle bar in driving these spikes. Where these plates are used with new or relaid track, the most convenient and economical plan for installation is to place the plates under the joints when the joint ties are respaced in the back work after track laying is completed.

The Abbott rail joint plate, being separated from the rest of the joint, is made of harder steel, with higher elasticity than the bars. The resistance it affords against deflection when all the joint members work together prevents the angle bars from bending or taking permanent set.

The device is made and sold by the Lackawanna Steel Company, Buffalo, N. Y.

The Otto Gas Engine Works have a new mixer this year. There is no reference to Teddy Snow nor Lazenby, as it is intended primarily for mixing water only.

Proceedings

The first session of the eleventh annual convention of the American Railway Engineering and Maintenance of Way Association was called to order at 9 o'clock a. m. on Tuesday, March 15, in the convention hall of the Congress hotel, by the president, William McNab, principal assistant engineer of the Grand Trunk.

The minutes of the last meeting were adopted without reading and the president then delivered his annual address.

President's Address.

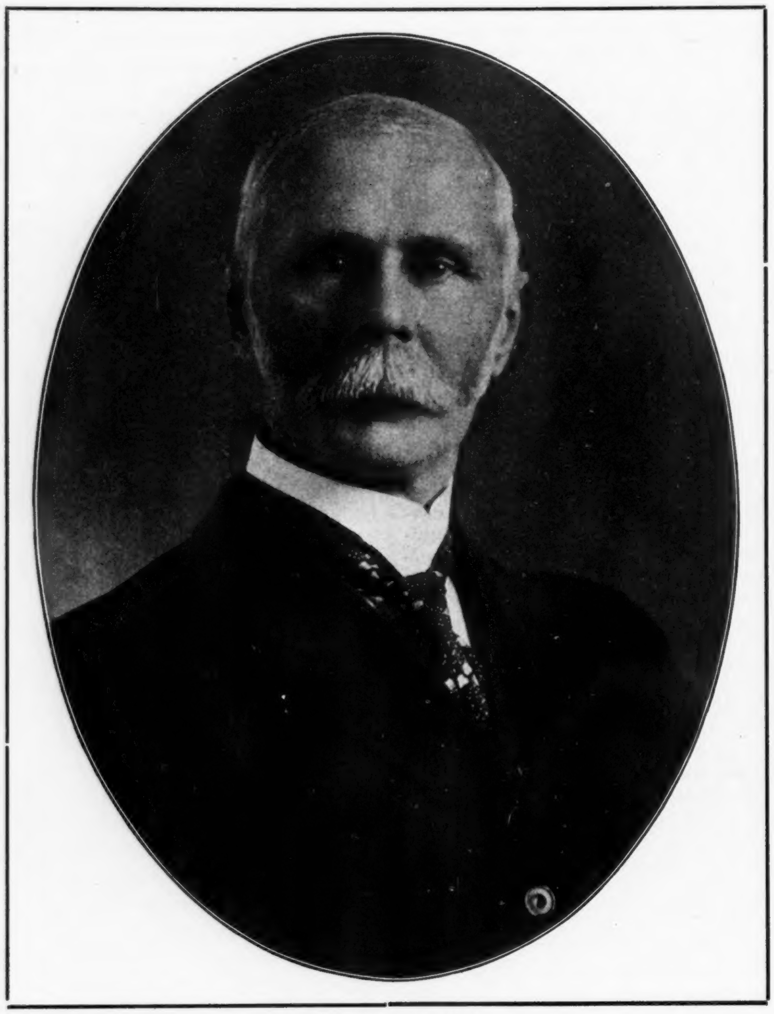
To the Members of the American Railway Engineering and Maintenance of Way Association:

At the close of the eleventh year of the existence of your association, it is gratifying to note that general progress and steady increase in activity have been manifested in every department of its work.

This progress is due not merely to additions in the association's membership and to the zeal of its officers, the committees and individual members in promoting the objects for which it was formed, but it lies also in the possession of a greater degree of that direct influence in the practical railway world which it has always been the aspiration of the association to attain. Seldom before have greater or more important problems in transportation matters, where such influence can be an aid, come before railway managements in general, than at the present time, and these conditions must be apparent to everyone who has kept pace with the improvements, as well as the methods of practice everywhere in evidence. More especially must they appeal to those who realize the value of technical and specialized knowledge as applicable to railways. Railways need specialists, and, to produce the best results, specialization is desirable; in fact, is a necessity.

The various committees of this association may be looked upon as specialists, as they are, in a complete sense, representative of every department of railway construction. In the assignment of work under the care or investigation of these committees, it is the aim of the board of direction to establish a line of policy which, if adhered to, will attain certain results; a policy the effects of which will demonstrate in a practical manner that in order to produce economic efficiency in train operation and the consequent permanent beneficial results in railway administration, economics as a science must be more carefully studied, and more generally applied in every feature of railway location, construction, operation and maintenance.

Although these committees are composed of specialists—and there is much efficacy in such a status—the association itself, acting as another great force, is predominant in blending into one harmonious whole the various interests involved. The influence, therefore, acquired by the association through the means of its conventions and supplemented by its Manual of Recommended Practice, serves as a great balance wheel in preserving that equilibrium of forces necessary for the success of any undertaking.



WILLIAM McNAB,
President.

During the year 1909, 4,886 miles of railway—exclusive of second, third and fourth tracks—were constructed and placed in operation in the United States and Canada, 1,138 of which were in Canada. Compared with the construction records of some former years, the amount added in 1909 did not increase the aggregate mileage to an appreciable degree, and, notwithstanding the recovery from the general stagnation in transportation matters which had existed, it might be a question whether or not during the year new railway enterprises and extensions of existing lines have kept pace with the increase in the industrial features of the country and its immediate

needs, due to the rapid advance in agricultural development now going on.

It is not, however, the purpose of this address to consider the reasons why the percentage of mileage added during the year was not greater, for it may be said that beyond having an interest of a general nature, such as may be accepted as universally shared in, it seldom comes within the special purview of the railway engineer to study in detail economic laws which govern eras of commercial prosperity. Neither does it directly belong to his province to question the attitude of the federal or state legislatures towards railway interests, or to analyze the complex factors which frequently produce the conditions leading to business stagnation or financial crises.

To the engineer, in such matters, the prime feature of import for the time being is trade and economic conditions as they exist, and it is in the degree in which such conditions are active that becomes the potential in his everyday life and avocations.

L. C. FRITCH,
First Vice-President.

From an engineer's standpoint, it is more desirable to anticipate the future and to consider and plan what has yet to be done, rather than to view the present situation in the light of what has not been accomplished. This statement, however, by no means implies that retrospect of work that has actually been done is unprofitable, for the members of an association such as this can well afford to review the records of construction of some portions of lines built during the past year. In the official descriptions of such construction it is clearly indicated that many novel and interesting engineering problems presented themselves for solution, and the progressive methods used in every branch of the work show that system, as applied to railway operation, has made a substantial advance and become more highly developed than in any other of the industrial arts.

In regard to lines and portions of lines built and placed in operation during the year, a review of the situation in general is convincing of the fact that certain extensions with a view to "transcontinentalism", and the construction of new roads with a similar object, was not only a feature of the year, but it contributed largely to the gross mileage built.

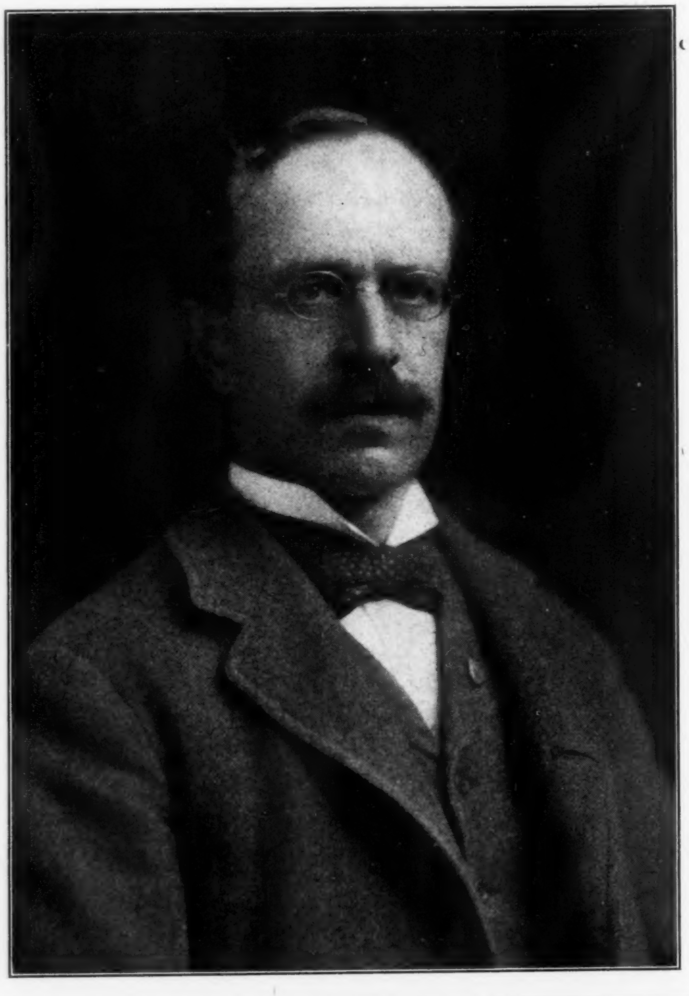
It is not possible, and even if it were so it would not be desirable in this address, to enumerate or analyze the general work of railway construction during the past twelve months. Suffice it in the meantime to quote one or two instances. The year 1909 has witnessed the advent at the Pacific coast of two of the large railway systems which had not until then physical access to that important section of the country. The Chicago, Milwaukee & St. Paul Railway System has been extended from the Missouri river to Seattle, Wash., a distance of 1,400 miles, 687 of which were built and placed in operation last year; and the Western Pacific, as representing the Gould system, has been opened for traffic from Salt Lake City, Utah, to Oakland, Cal., a distance of 924 miles, 440 miles of which were built in 1909. Two other roads, at present under way, viz., the Spokane, Portland & Seattle, and the Kansas City, Mexico & Orient Railway also will, when completed, form parts of transcontinental systems respectively.

Another undertaking, transcontinental in a complete sense, and greater in magnitude than any other single railway proposition that has been built at one time on this continent, viz., the Grand Trunk Pacific, and National Transcontinental is at present being rapidly constructed on the most approved modern lines from the Atlantic to the Pacific and entirely within the Dominion of Canada. The length of the main track of this railway will be 3,561 miles. Of a total of 1,500 miles now constructed, 500 miles were built and placed in operation in 1909, and 1,200 miles more of main track are at present under construction. It is interesting to note that the whole of the main line of this railway has been permanently located. It crosses the Rockies at an elevation of only 3,712 ft., and is being constructed on an entirely low-grade basis. It has only one summit between the prairies and its western terminal, Prince Rupert, on the Pacific coast, and with the expection of

a stretch of 20 miles, where the grade is 1 per cent., its ruling grade through the mountains is 0.4 of one per cent. It will not be difficult to realize, therefore, that the line will be admirably conditioned for heavy traffic, and, further, that exceptional features concerning location have been the means of obtaining at the very outset this unique condition.

Such revision work, double-tracking and other permanent betterments (as distinct from ordinary maintenance) as have been undertaken throughout the country have been characterized by mature judgment in carrying them to completion. The longest individual stretch of double-tracking an existing line which had been in course of construction (but actually completed during the year), was on the Canadian Pacific, from Fort William, Ont., to Winnipeg, Man. The distance between these two points is 417 miles. In conjunction with this work the limiting grades against east-bound traffic were reduced from 1 per cent. (not compensated) to 0.4 of one per cent. (compensated). In order to obtain such a reduction reasonably, it was found desirable and more practicable to take advantage of the physical conditions of that section of the country, and locate the new east-bound track in some places beyond the right-of-way of the existing line, in lengths varying from 0.6 of a mile to 5 miles, and in distance from the original track of 500 ft. to 7 miles. The ruling grade of the west-bound track was at the same time also reduced from 1 per cent. to 0.4 of one per cent. except for a distance of 54 miles, which is still 1 per cent. and operated as a pusher proposition.

Among the most notable of the railway engineering structures which were completed during the year may be mentioned the Susquehanna bridge of the Baltimore & Ohio Railroad at Havre de Grace, Md., a double-track structure, the total weight of the steel being 16,000 tons. Three of the piers of this bridge were sunk in the bed of the river by the caisson process to solid rock foundations at depths varying from 60 to 75 ft. below tide.



W. C. CUSHING,
Second Vice-President.

Also, the Lethbridge viaduct over the Belly river on the Crow's Nest branch of the Canadian Pacific Railway. This bridge has 66 spans of deck plate girders and one deck lattice truss, which are carried on rigidly-braced steel towers. The magnitude of this work may be realized when it is stated that the steel structure is 5,327 ft. long, 314 ft. from the bed of the river to rail and contains 12,200 tons of steel.

The new bridge of the Pittsburg & Lake Erie Railroad over the Ohio river at Beaver, Pa., is so nearly completed as to be consistently mentioned at the present time. This structure is a double-track one, 1,787 ft. long, and replaces a single-track bridge. The new channel span is 769 ft., as against 443 ft. in the old. The old bridge was erected in 1878, at a time when the use of falsework was permitted, but the present one, being of the cantilever type, has been erected without interruption to navigation. The trusses were designed for Class E-55 locomotives and the floors for Class E-60 locomotives, with full allowance for impact. The superstructure contains 16,500 tons of steel.

The new spiral tunnels of the Canadian Pacific Railway in the Rocky mountains are particularly worthy of mention as being the first introduction of this particular system of tunnels on this continent. The original line of this railway between Field station and Hector station (known as the Kicking Horse Pass) was constructed for a distance of 4.10 miles with a 4.5 per cent. grade. In order to improve such conditions, only one proposition was feasible, namely, a development one, involving certain tunneling, with a consequent doubling back for some distance as well as crossing the Kicking Horse river twice. There are two tunnels, one of them 3,255 ft. long, on a reverse curve, and the other 2,921 ft. long, partly on a 10-deg. curve and partly on a tangent. The curves have 300 ft. of spiral at each end. The new grade in general on this deviation has been reduced from 4.5 per cent. to 2.2 per cent., compensated, except in the tunnels, where 0.6 per cent is used. Work on the tunnels was started from both ends, and despite

the complicated work caused by the spiral shape, the two headings met with the levels checking in one case to 1-100 of a foot, and in the other to 2-100 of a foot. The reduction in gradient from a 4.5 per cent. to 2.2 per cent. on this particular section necessitated an increase in length of track of 4.50 miles.

It is interesting also to note that in the month of November last, although not as yet completed for ordinary operation, a Pennsylvania Railroad train passed through the Hudson river tunnels for the first time.

In the carrying to completion of the railway engineering structures mentioned and many others built during the past year, as well as in most of the great number in course of construction throughout this great country, an influence traceable primarily and directly to the organization and working of the American Railway Engineering and Maintenance of Way Association, and which has already been referred to, is apparent, and such influence has been manifested, as well, in the development of every important detail connected with this particular section of industrial activity.

As far as the direct interests of the association and the work of your committees for the past year are concerned, it will be observed that for satisfactory reasons the reports of two of these committees are merely those of progress, but they are indicative of excellent material which will be worked upon, and from which practical information will eventually be obtained. A reference to the other reports will be self-convincing of the businesslike and scientific manner in which the details under investigation have been dealt with and focused to conclusions by these respective committees, and which you will be asked to pass upon in open convention.

The American Railway Association has placed at our disposal the means for employing an expert to superintend the tests of rails at the several mills on a uniform and scientific basis. Such tests will be carried on under the direct auspices of your Committee on Rail. Valuable results are confidently expected from the work thus to be undertaken. Good rail being of fundamental importance to a railway, this committee has been most zealous in its determination to leave nothing undone that will bring about conditions in design and manufacture that will be satisfactory to the railways in general.

The board of direction has for some time past been considering the advisability of revising the existing constitution of the association. Some of the changes proposed are minor in character, while others are more far reaching in their scope. The present form and the proposed form have been printed and issued to the members for their consideration, and it is suggested that each one of the proposed changes be carefully studied in order that the final vote may be looked upon as given after earnest consideration of future effects.

Last July our esteemed treasurer, Mr. W. S. Dawley, who had occupied that honorable office acceptably since the formation of the association in 1899, tendered his resignation as such to undertake railway construction work in China. The board of direction realizes that the association had in Mr. Dawley an efficient officer, and desires to place on record its regret at losing one who had rendered valuable services, not only as a member of the board, but also as custodian of the finances of the association during the past ten years.

C. F. LOWETH,
Treasurer.

We have lost a number of valuable members by death during the year, among them being H. F. Baldwin, at one time a director of the association; James Keys, vice-chairman of the committee on Wooden Bridges and Trestles (Mr. Keys has contributed very materially to the success of his committee and we are indebted to him for a large amount of valuable data); G. A. Casseday, another member of the same committee; J. W. Schaub, a valued member of the Masonry committee for a number of years; E. J. Randall, H. M. Steele, and James C. Gray.

At the close of your President's term of office as such, he desires to acknowledge his appreciation of the hearty co-operation of the Board of Direction, as well as of the member-

ship in general, in his efforts to satisfactorily administrate the affairs of the Association. It affords him much pleasure to feel that the Assocation stands on a high plane, and having been intimately connected with its work from the beginning, he would be devoid of proper spirit did he not feel that his practical interest in that work would never lessen.

The secretary then presented the report of the secretary and treasurer, which showed the following financial statement:

Receipts during the year	$19,758.08
Expenditures during the year	21,203.40
Excess of expenditures over receipts	1,445.32
Balance on hand March 10, 1910	16,403.01

The statistics regarding membership were as follows:

Total members 1909 convention		784
Members admitted during the year		101
		885
Deceased	7	
Withdrawals	4	
Dropped	5	16
Membership March 12, 1910		869

Discussion of Report on Uniform Rules.

L. S. Rose (C. C. C. & St. L.): I would move the adoption of the rules as presented.

L. C. Fritch (C. G. W.): I second the motion.

Mr. Rose: There is some objection to the third rule of the rules governing track foremen, as regards the words, "at least once a day," in the second line of that paragraph. It is thought by some members, and I think so myself, that it is unnecesary to prescribe that there should be a track foreman or a track walked every day on all sections, and there ought to be some rule or modification. A railway man would modify this rule if he were applying it to his own road, especially if he had only one train a day or one train a week on the road. He would probably allow the engineer or the inspector to be the track walker, and I think there ought to be some slight change in that rule.

The President: What change do you suggest?

Mr. Rose: I would make it apply to Class A track or Class B track.

Joseph O. Osgood (C. of N. J.): Some of these rules, and notably the one to which Mr. Rose has referred, should properly take the place of the rules prepared by the Committee on Track. I wrote to Mr. Rose advising him of what we had done, calling his attention to the revision of the rules, and especially to the rules which had been prepared, which would naturally take the place of those prepared by the Committee on Track, and asked him if the rules as we had prepared them were satisfactory to the Committee on Track, stating that some discussion might be avoided if they were. He replied he saw no objection to them, and later he advised me that one member of his committee took the position which he now states in regard to this particular rule being too severe on roads of very small business. As I understand Mr. Rose in what he has just stated and what he wrote to me, it seemed a hardship that a road having a small amount of business should be obliged to send a man over the track every day, and I can conceive of a case in which that might be a hardship, but our idea in preparing these rules has been that they could not be made to fit every body's condition; that all we could do would be to prepare rules which would be satisfactory in ordinary cases, and which could be adopted where ordinary conditions prevailed and where traffic was very severe they would doubtless have to be added to materially, and there might be some exceptions made. I am afraid it would be difficult, indeed, to frame any set of rules so comprehensive as to meet the conditions Mr. Rose mentions, and all other conditions and not make a volume of it, a volume containing exceptions, interlineations, and many things which would be hard to take care of.

G. A. Mountain (Can. Ry. Com.): I agree with the committee, that it is a proper rule. The fact that you have one train or twenty trains a day over a piece of track that is not inspected, is of little consequence. One train may go into a washout and probably the twenty trains would go through all right. Probably the track should be walked every day of the year. I feel very strongly on that point, and I back the committee very strongly on that. I think it is a good rule and a rule I am satisfied the Canadian Railway Commission will enforce in Canada.

Mr. Rose: The last speaker has merely hit my position. If you have passenger trains, I think you have Class A track. You may have a road where you have mixed trains, and I think there is going to be considerable mileage of that sort of road in this country, where the trains run slowly and the track is poor, and if there is a washout the engineer will have time to see it and stop. If this association adopts such a rule some of the roads will get us on the carpet and cite this rule and the action of this association. If it is really put up to a railway manager, he will understand it is unnecessary to do that. The track committee, after receiving Mr. Osgood's letter about the overlapping of the rules in the Manual, page 66, subdivision of track, voted to withdraw all the rules under "Inspection of Track." They have no objection to withdrawing those rules, and I have been authorized by the committee to make such a statement, although we do not incorporate that in our report. We feel that the rules as outlined in the report of the committee are all right.

C. E. Lindsay (N. Y. & H. R. R. R.): I don't want to divert attention from the particular rule, but I would like to call attention to one or two minor points in the rules governing the general organization, and the rules governing track supervisors. The first rule on organization says that the man in charge of the maintenance of way department receives instructions from and reports to ———. Rule 1, governing the track supervisors, transposes this expression. He first reports to and receives instructions from ———. It seems to me that these two might be made to read the same. In Rule 2 of the rules governing track supervisors, I think tunnels are of quite sufficient importance to be placed definitely under the responsibility of the track supervisors, as well as the station grounds, and tney are of sufficient importance to warrant mention in Rules 2 and 3. I think, also, that the committee has not incorporated a very essential rule for track supervisors, which is that it is the duty of the supervisor not only to select men but to train men for the position of foreman. I think the railways of the country to-day are suffering more, perhaps from the lack of properly trained and competent foremen than any other thing in the labor world. In Rule 5, I suggest that the supervisor must not only know that the foremen are familiar with the operating rules, but that he is supplied with the proper signaling and flagging appliances. Another duty that devolves on the track supervsor is the removel of snow and ice, which seems not to have been mentioned specifically by the committee.

Mr. Osgood: The first point raised as to the words "The Maintenance of Way Department on each division is in charge of the ———," which appears under "Organization," and the words "Track Supervisors shall report to, and receive instructions from the ———," which appear under the rules governing track supervisors, and the fact that these read somewhat differently, I think is simply because attention was not called to the matter. I do not think we should make any difference one way or the other—I think it would be better to have them both the same way. As to the question of including tunnels, etc., I do not think that that was discussed. If we begin to mention tunnels and go too much into details of the roadway, we are simply adding to the length without increasing the efficiency of the rules. It may be open to question whether it would be wise to put "tunnels" in, but I am very much opposed to the general proposition that we should add to the rules, because I believe when we add one detail the omission of another is evident, and so it goes on until the thing becomes so large and extensive it is of no use.

L. A. Downs: (I. C.) The last sentence of the fifth rule governing track foremen reads: "Foremen must provide themselves with reliable watches, and when possible, compare time daily with a standard clock, or with conductors' watches." It specifies only two ways of getting the correct time. I think that should be changed to read: "Foremen must provide themselves with reliable watches, and when possible compare time daily with a standard clock or with the watches of other employes whom they know have the standard time."

Mr. Osgood: That was discussed at considerable length, although I do not think the particular expression mentioned was thought of, but our conclusion after discussion pro and con, was that it was better to leave it as it is, not adding anything more to it. If the convention thinks otherwise, we are open to correction.

Mr. Downs: Am I to understand that the foreman could not get the time from an engineer?

Mr. Osgood: Not at all; it does not prevent his getting the time from the engineer. We do not undertake to tell him all he should do. We undertake to have him clearly understand that he must be supplied with the correct time.

Mr. Downs: My idea was to make the rule broader.

Mr. Osgood: I do not see any serious objection to it except that it adds length to the rule.

J. E. Taussig (Wabash): I suggest that it be changed to "Trainmen's watches," for the reason that all trainmen are subject under the rule to standard watch inspection—permit the foreman to confer either with the engineer, conductor or brakeman.

W. G. Brimson (Q. O. & K. C.): I agree heartily with the committee. Under the standard rules the last duty of a conductor is to get the time from a standard clock, and he is coming directly from the source of time and the section foreman if he gets his time from the conductor will be getting just as near to a standard clock as possible. I doubt very much if other trainmen would have watches which would be comparable with that of the conductor. I think the conductor has the most reliable time next to the standard clock.

James Burke (Erie): I agree with Mr. Downs that if any trainman should have the time, the locomotive engineer especially should have it. Sometimes the section foreman may be standing close to an engineer, whereas he would have to go clear to the rear end of the train to get the conductor's time.

Mr. Lindsay: I am in hearty agreement with Mr. Downs; but in order to keep the discussion seriatim, I move to amend Rule 2 by the omission of the words "Station grounds and driveways." It seems to me those words are not of sufficient importance to warrant specific mention in the rules.

G. D. Brooke (B. & O.): Before that motion is put to the house, I would like to say the reason those words were included is that the station grounds and driveways, especially the station grounds, are apt to be neglected by the station men, unless they are brought particularly to their attention, and for that reason the committee thought it proper to include these words in the rule.

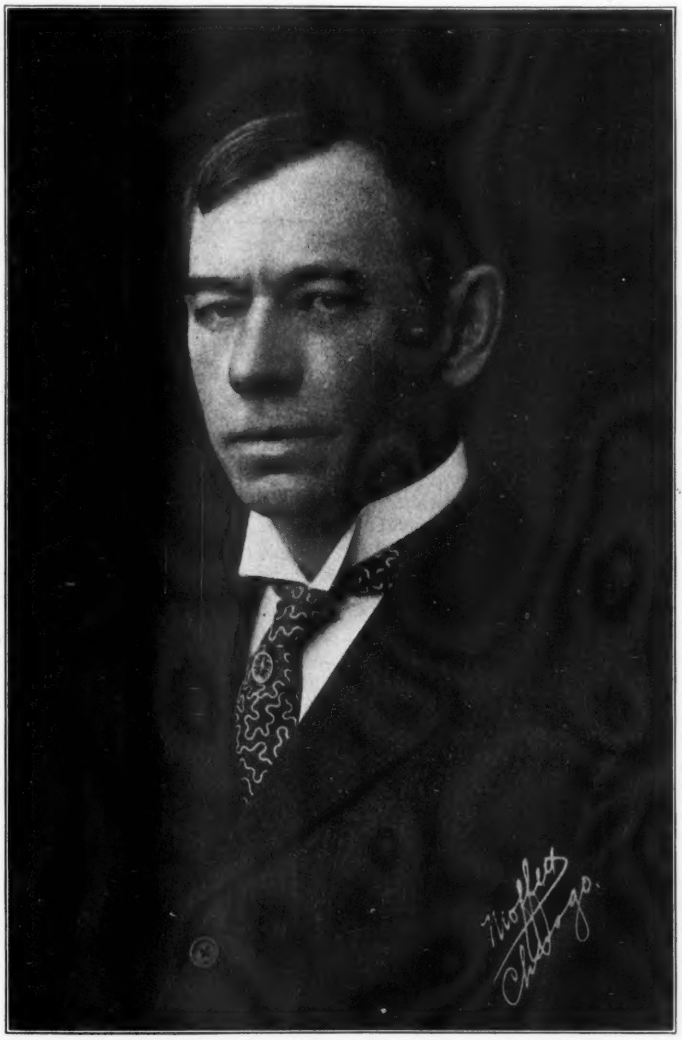
Mr. Lindsay's motion was put to vote and was not carried.

C. Dougherty (C., N. O. & T. P.): As a compromise, I move to strike out the word "driveways." These are generally on the station grounds, and to that extent the word might be considered as redundant.

The motion was put to vote and was not carried.

Mr. Downs: In order to put the matter before the house, I move that in the last sentence of the fifth rule on track foremen we substitute the words "standard watches of other employes," in place of the words "with conductors' watches."

Mr. Lindsay: The practice on the New York Central is to go further, and permit the section foreman to compare his watch with trainmen's watches. All trainmen have their watches inspected and certified, so that every trainman's watch is a certified watch. We also require supervisors of track to have certified watches, so that the foremen could compare their watches with the watches of the supervisors of track if there were no trains on the road. I will heartily endorse the motion made by Mr. Downs, except that the word "certified" be used instead of "standard," and hope it will prevail.



E. H. FRITCH,
Secretary.

Mr. Rose: It seems to me the fact is overlooked that the section foreman might get his time from the telegraph office, if he were around while the time was being sent.

T. C. Newbegin (B. & A.): On many sections, the section foreman on duty in outlying places never sees a conductor except on trains going by. Unless the rules permit him to compare time with any employe who carries a standard watch, he has no means of securing this standard time.

C. C. Anthony (Penna. R. R.): I object to the words "certified watches" for the reason that some roads do not have the watches certified. I suggest that the exact wording of the change be left to the committee. The committee understands now what is wanted, to get a little broader provision for securing the correct time.

The president put the motion made by Mr. Downs, which was not carried.

Mr. Rose: I move that Rule 3 of the rules governing track foremen be changed to read by prefixing the following to the rule: "Except in case of roads with very light traffic, they must go over their sections," etc.

The President: Do you not think, when you express it that way that you leave it up to individual discretion of what "light traffic" means? If you specify it in some description of the road, Class A or Class B, would you not think that would be better?

Mr. Rose: The present rule in the Manual reads as follows: "Except in cases of roads of very light traffic, all main tracks shall be inspected each day by section gang or track walker." My idea is to incorporate this in Rule 3 on track foremen.

Mr. Anthony: I think we are now getting rules and specifications mixed up. These are rules addressed to the track foremen, and it certainly would not be up to the track foreman to decide that the traffic was so light that he did not need to go over his section once a day? If this change is to be made, it seems to me it should be worded in this way: "Unless otherwise specified." Then it is up to his superior officer to tell him whether or not to go over the road.

Mr. Osgood: The committee will accept the modification suggested by Mr. Anthony if it is satisfactory to Mr. Rose.

The report as amended was adopted.

Discussion of Report on Signals and Interlocking.

A. H. Rudd (Penna. R. R.): I move the adoption of the revision of the Manual, Subject 1.

L. C. Fritch (C. G. W.): As to the specification for rubber insulated wire, I ask the committee if it would favor a change in the requirements for voltage, making it 660 volts instead of 600.

The President: The committee will accept that amendment.

Mr. Rudd then read an answer to the objections contained in the minority report to the committee's report on subject No. 2, uniform system of signaling. This reply of Mr. Rudd's is published in another column. Mr. Rudd then moved the adoption of the report of the committee on subject No. 2, including the conclusions.

Motion seconded.

The President: We see that this committee, as a whole, is not a unit. The minority has brought in a report which seems to me, in a sense, to be a criticism without a substitute, and this minority report, together with the chairman's criticism of it, must be accepted in the form of discussion. It seems to me that, if there is very much divergence of opinion, it might be well to have this report referred back to the committee to see if the committee cannot as a whole harmonize some of the points at issue, rather than take up the time of the convention in settling the points which the committee has not decided upon itself.

T. S. Stevens (A. T. & S. F.): The reason the minority, so-called, submitted no scheme of signals, was because it did not feel that this association was at liberty to decide between one or two schemes. We felt that that was committee work. I would like to answer one thing stated by the chairman. I will not answer the whole report. I want to say there are railways in this country that are adopting the views of the minority, taking the signal "proceed," and such things, out of their rules this year, for a purpose.

L. R. Clausen (C. M. & St. P.): The work of the committee as regards subject No. 2, method of uniform signaling, has been carried on for about four years in this association, and for about five years in the Railway Signal Association. The subject was suggested by the committee itself. Probably because of the diverse practice throughout the country in the art of signaling, the desirability of uniformity has not been so clearly shown, and has not been dwelt upon by the committee in this discussion very particularly. The work was started in the Signal association, and annually reports have been presented by its committee on signaling practice, resulting, in October, 1909, in a final report which was presented with the recommendation that it be adopted. Each year in the Signal association saw a change in the committee's report. They were all progress reports until 1909, when the report was recommended for adoption. In 1909, the Signal association voted to submit the report to letter ballot. The result of that vote was 236 votes for the adoption of the report and 311 against the adoption of the report. That 311 does not include 25 votes of the Chicago, Milwaukee & St. Paul against the adoption of the report, which were not received in time to be counted on account of the question of the number of votes we should be allowed. If those 25 were counted it would make 236 for and 336 against the adoption of the committee's report. The report is exactly the same as subject No. 2, now presented to this association with recommendation for its adoption. The work of this association begins with the 1907 reports, and you have the report before you in your proceedings for 1907, 1908 and 1909, each year showing a material change in the report. This year you have presented to you a report with recommendations of the chairman and a majority of the committee for the adoption of a report be adopted which is clearly a change from last year. There are 18 members of the committee who have voted for this report and five members have not concurred. I am referring to subject No. 2 of the report only, and the minority report bears only on subject No. 2, not to any other subject of the committee's report. These eighteen members represent seven roads or systems, five not concurring. There are four members representing four different roads or systems who have voted for the minority report. The men who compose the minority hesitated somewhat before they made the report in as much detail as they finally submitted it, because of the fact it would take up too much of the association's time to read and discuss it. It goes too much into technical detail. In a few words, the minority's criticism of the report as presented to you is that there is an attempt to provide too much information to the engineman. We feel that the practice of to-day does not require that that information be furnished, and that it is a decided mistake to attempt to furnish it. We feel that unless you can say something to the engineman that is absolutely reliable you would better not say anything at all. The report, as it is presented to you, provides that the distant signal shall be a repeater of the home signal. The distant signal cannot be a repeater of the home signal, regardless of how you connect it up. It often is in the clear position and the home signal is found against the runner. It is often in the "caution" position and the home signal is found clear, due to various causes. That signal should not say what the position of the next signal is, but it should say to the runner only "caution" or "proceed," either one or the other. Any attempt to make a distant signal a repeater of a home will encourage laxity on the part of the engineman because he will be in a measure relieved of the responsibility of looking for the home signal. There have been to my knowledge three or four disastrous wrecks on railways during the past few months which are very illuminating in that respect; they are very interesting because they show just that weakness. The chairman has ridiculed the position of the minority, that the clear block signal should not mean to the engineman a clear block section. A clear block signal is one thing and a clear block section is another. The art of signaling has not reached a point when we can say to an engineman, with reliability, that a clear block signal means a clear block section. We have not reached that point in railway operation at present, and unless you can say that to him and guarantee it you don't want to say it. You want to say to him that a clear block signal means "proceed" and only proceed. It does not mean "you are going to find the block clear;" it means "you can go." The chairman has ridiculed our stand in regard to this question and asks what block signals are for. I will answer and say the conception of the minority in regard to the block signals is that they are introduced to place trains; they mean "stop" in one position and "proceed" in another; or, if to be used in "caution" position, you have a third indication which says "caution." The main difference between the minority and the majority revolve around the question of the meaning of a distant signal to an engineer, and the meaning of a clear signal to an engineer. I wish to, if possible, remove an impression that you may have gained from the remarks of the chairman, with regard to the American Railway Association code and the report submitted by the majority. He probably left with you an impression that the majority report is in accordance with present practice and that it complies in every respect with the A. R. A. code. We wish to dispute that statement, and I wish to say that in the A. R. A. code you will find but four indications, "stop," "caution," "proceed," and under the head "automatic block" you will find the fourth one, "approach next signal prepared to stop." How the majority can expand those four indications into the fourteen at present in the report is beyond my understanding. In view of the arguments which we have presented in our reports and in view of the committee's action in annually changing

its report, in view of the substantial minority on the committee which is against the report, in view of the action of the Railway Signal Association in turning this report down by an overwhelming vote, I believe the report should be returned to the committee for further consideration.

Hunter McDonald (N. C. & St. L.): I move, in lieu of the pending motion, that subject No. 2 be referred back to the committee for further consideration.

Motion seconded.

Mr. Fritch: The committee has done very hard and intelligent work on this report, and as this matter goes to the A. R. A., anyway, for adoption or rejection, I can see no harm in having it passed upon at this meeting. If the minority of the committee has something better to offer or something in lieu of this to offer, they should have given us something so that we could choose between the two. Many of us are putting in new automatic block signals, and we want the most modern practice. We don't want to make an installation that is expensive now and in a year or two change it. I hope the committee's report will be adopted.

Mr. Rudd: The conclusions endorse the report of the committee as a good system, and refer it to the A. R. A. for its consideration. Now, you can leave this a year, or two or three years, before sending it to the association. Perhaps the association will do something without your sending it anyway. It is a subject on which this associotion ought to take some action, some day. But you can't settle it. The A. R. A. is the association that has to settle the indications and the aspects, but this association, on account of its knowledge of signaling, what can be performed by signalling, and what cannot be performed by signaling, is in a position to make recommendations to the A. R. A. for a uniform system. It simply devolves on the point whether you are ready to do that or whether you don't wish to do it.

B. H. Mann (Mo. Pac.): I hope that the report will be referred back to the committee for further action, for the reason that we have here a strong majority report and a strong minority report. The point is made, as well, that each year has seen a change in the form of the majority report. It may be a slight one. There are two questions. One is the question of engineering, in which there seems to be but very little divergence. The second question is the transportation matter, the handling of the engineman on the train. The entire variance in opinion seems to be a question as to how the railway shall handle the trainman after the train is in motion on the road, on the schedule. The committee seems to have entirely overlooked the fact that this signal, you might say, is a sudden instruction to depart from the schedule, just as a No. 31 order. Ever since the train order has been in practice, one sacred thing has been that there shall be no written or other instructions that will qualify the train order; the train order as delivered to the man on the engine and the conductor means only what it says. This means that the engineman, when taking a signal on a high speed train, must think back to this printed or written instructions to ascertain whether the yellow signal, for example, means proceed. He may three miles in advance find a signal against him, but must maintain his schedule in the interim, or else it means an earlier restriction. In referring questions on transportation to the A. R. A., this association ought to have a unanimous report. I think the president is right in his first suggestion that as we have these two reports, the committee should be given one more opportunity, at least, to harmonize the reports.

Mr. Stevens: The chairman's report to the association shows that I did one day's work more than any other member of the committee on this subject. That did not take into account the large amount of work I did in my office. I had monthly reports in Chicago for something like five months, which entailed an expenditure of nearly a week's time of part of my office force getting out reports and blue prints, so that the minority has been working on this matter earnestly and sincerely, and this report is made after that earnest consideration, feeling that this association cannot afford to send this report to the A. R. A. in its present condition.

The President: It has been moved and seconded that subject No. 2 be adopted. An amendment has been moved, duly seconded, that subject No. 2 be referred back to the committee for further consideration, presumably on account of the divergence of opinion it the committee itself.

Howard G. Kelley (Grand Trunk): Before the motion is put, I wish to ask for some information. The difference of opinion on this committee is basic. They agree on methods, mechanical and engineering. Their difference is, therefore, on the theoretical side or the train movement side. The members who have submitted a minority report are men of long experience, representing many thousands of miles of railway, and I believe that we agree with the majority that we owe an obligation to the minority to allow them an ample opportunity for discussion in a manner that will enable them to settle the controversy. Well, how can they settle it? I believe by referring the matter back to this committee, it will not approach a settlement; that it will not help a situation. The only way that occurs to my mind is whether a settlement can be reached by requesting the Committee on Signaling of the A. R. A. to discuss these basic principles with our committee and ask them for information. It seems to me that is the only way we can arrive at a unanimous opinion. The gentlemen on this committee are represented on the A. R. A. by their companies. I feel that the gentlemen composing the minority have their railway operating officials behind them in their report, the same as the majority have their operating officials behind them. It is one of our hardest working committees, I believe one of our most conscientious committees, and they have reached a point where they cannot, as expert signal men, come together. We as an association must not recommend to the A. R. A. anything that does not bear the unanimous stamp of the committee that reported it to this association. We must send it before the A. R. A. without a dissenting vote. I ask the members of this committee whether, by referring the matter to a committee of the A. R. A., and having a joint discussion between the two committees, they can come before us next year with an agreement and settlement of some of these divergences of opinion. Some men will have to give way, some men will gain their point. but even if that can't be done I believe that is the way we should proceed. I should certainly hesitate to support Mr. McDonald's motion to refer the matter back to the committee for another year. If we do that, when the matter comes before us next year we will most certainly have another dissenting report.

Mr. Rudd: Three years ago, I think such procedure would have been feasible. The Signal Association adopted a report very much on these lines as a progress report, and referred it to the joint committee of the American Railway Association for its opinion. That report was referred to the joint committee of the A. R. A., and that joint committee is now dead. I do not know whether that report killed it or not but it went out of office, and I presume that the report went out with the joint committee. Now, whether we will get any better action by having this committee try to take the matter up with the Signal Committee of the A. R. A., I do not know. It would seem to me that the way out might be for this association to refer these reports, both majority and minority, to the committee of the A. R. A. and ask them to give a ruling on the points at issue. It seems to me that is about the only one of three ways to settle it. There are two other ways: One is to remove the minority members from the committee, and the other is to remove the majority members from the committee. I do not think, with the views which we hold on the basic principles, that we will ever get together on a recommendation. I would like to ask Mr. Stevens and Mr. Clausen what they think of that, whether they believe there is any chance of our getting together on that question of distance. They made fun of us and we make fun of them, but it has ceased to be a matter of fun, and we have got to get down to business. I do not believe we can get together in that way.

Mr. Clausen: I think that if this committee had an opportunity to discuss this entire question of signaling with a proper committee from the A. R. A. we could get together. I do not think there is any question about it. It would all depend on the manner in which the matter was discussed and how much weight the committee gave to the opinions of the gentlemen of the A. R. A. But I do not think there is any question but we could get together on the matter and bring in a report which we could all sign.

Mr. Fritch: I want to make an amendment to the amendment, that this report be referred back to the committee with instructions that the committee confer with the committee on Signaling and Interlocking of the A. R. A., with a view to bringing in a harmonious report at the next meeting.

Mr. Rudd: Would you embody the suggestion that the A. R. A. committee confer with us?

Mr. Fritch: I have no objection to that.

Frank Rhea (Gen. Elec. Co.): As I understand it, there is no such committee of the A. R. A. at the present time, but Mr. Kelley's suggestion is certainly pertinent and in my

opinion is a proper way to settle this problem. The signaling question is divisible into two distinct parts: One is an operating part and the other is a signaling part. The indications are the operating questions. This committee has been working all these years without an authoritative outline of what the indications should be. If the A. R. A. will settle the requirements in the form of a proper set of indications, the matter then reduces itself to a question of aspects, and I think that will be the happiest way, and the only way, by which this subject will ever be settled.

Mr. McDonald: I accept the amendment to the amendment.

The President: The amendment as it now stands is that this subject No. 2 be referred back to the committee with instructions to that committee to confer with a similar committee of the A. R. A., with a view to harmonizing, if possible, the differences between the majority and the minority reports of this committee.

Mr. Mann: I hope that that amendment will not go to the A. R. A. in that way. It would seem as though the dignity of this association calls rather for an arbitration on questions that perhaps are not pertinent to the work of our association. This body in a dignified manner could ask for that arbitration, and the Committee on Transportation of the A. R. A. could refer back to this association the settlement of the engineering questions.

Mr. Rudd: I have asked the members of the committee concerning this, and they feel that that method of disposing of the matter will not cast any reflections on the committee. I move that the remaining subjects, No. 3, No. 4, etc., on which this committee has reported, be adopted as progress reports.

Motion carried.

Discussion of Report on Electricity.

J. B. Austin (Long Island): In explanation of the form in which the report is presented I will say that this is a new committee on a new subject, and in gathering information we find it takes rather more time, possibly, than in a case of a subject that has been under discussion for some years. We have had four meetings of the general committee and about ten or eleven meetings of the various subcommittees, but we feel that our foundation work has not progressed far enough yet to enable us to draw any definite conclusions, or present any recommendations to the association for adoption. I move the adoption of the report of the committee.

Motion carried.

There was no discussion on the report of the Special Committee Co-operating with National Conservation Commission.

Discussion on Iron and Steel Structures.

Group 1 of the specifications was adopted, without discussion.

The secretary then read the first paragraph under group 2.

J. E. Greiner (Consulting Engineer): The only practical difference is that we made the height one foot more than before. It was 21 feet before and we thought it advisable to make it 22 feet. We have illustrated the clearance by means of a diagram. The change is really of no great importance.

Mr. Mountain: According to the Railway Act, bridges built in Canada are required to be 22 ft. 6 in. from base of rail. The idea is to give 7 ft. over the running board of the highest car.

Mr. Greiner: I think 22 feet is based on some laws in this state. This merely means the minimum clearance. If there are no other restrictions you could make it as high as you want. I think the majority of the roads in this country have established 21 feet from the top of the rails.

This clause was accepted, and the secretary then read clauses 6 and 13.

Mr. Greiner: The original clause was a little indefinite, and we thought that it would be better to fix the degree of curve for which centrifugal force should be calculated. That formula simply means that for a 10-degree curve the speed is 35 miles an hour, and on a tangent it is 60 miles an hour, which, in our opinion, is ample provision for the centrifugal force in connection with the other force.

T. L. Condron (Consulting Engineer): Is it intended that the impact formula shall be applied to this as treated as live load?

Mr. Greiner: No.

Mr. Condron: It says: "Shall be considered as live load." Live loads are subject to impact formulas.

Mr. Greiner: I think you will find in the specifications we state that the impacts are not to be applied to centrifugal force. I think that is taken care of.

The secretary read clause 16.

Mr. Greiner: The change in that clause is limiting the original compression formula to 14,000 lbs. In the old specifications we use a simple, straight-line formula, without any maximum, and we thought it advisable to fix that maximum at 14,000 lbs., based on bending tests on full size members which are now being undertaken. Then there is another addition to the clause which is giving a unit stress of 16,000 lbs. for steel castings. These are not in the original specification.

Mr. Kelley: As to adopting a minimum of 14,000 lbs., is that based on any series of experiments? For a number of years, in using a similar formula, I had been limiting it so that it gave me 13,500 as the maximum.

Mr. Greiner: It was simply a compromise. There are not enough tests made on steel compression members at the present day to enable us to settle that with any degree of certainty. Our old formula would allow 16,000, or pretty near it, for short columns. We felt that to be conservative it would be better to reduce that 2,000 at any rate. Some members of the committee thought we should get down to 12,500, ut we compromised on 14,000, pending the results of the full-sized tests that are being undertaken.

As to clause 17, the old specifications for bending did not provide any bending on steel castings. We made the addition of 16,000 lbs. for bending steel coastings.

As to clause 19, the old specifications gave a bearing value of 600 lbs. per square inch on granite masonry and Portland cement concrete, and 400 lbs. per square inch for sandstone and limestone. We have simplified that by making a uniform bearing value of 600 lbs. on masonry.

The secretary read clauses 18-a, 19-b, 21 and 27, which were approved.

Mr. Greiner: As to section 28, in the old specifications, we gave a formula for the maximum length of the compression flange of the girder. That applies to girders when flanges are composed of angles and flat plates. We thought in this revision that we had better take care of other kinds of girders, such as those which have a channel, the flanges of which are rather long and without lateral support, and that is the object of this change of formula when the cover consists of a channel section.

The committee would like to make a further slight change in clause 45, as there has been some question as to whether the shearing stresses should be determind from a uniform load or from a concentrated load. We would add after the word "flexure" the words "uniform load."

Clause 66 was changed on account of the gradual increased weight of our moving loads, so as to take care of that in the future.

As to clause 79, the old rule, one that has been in quite general use, was to increase the length of the top chord ⅛ in. for every 10 ft., to provide for camber. It is all right for a very small span, but when you get up to 400 or 500 ft. spans you must take care of the camber in the manner provided here.

C. C. Schneider (Consulting Engineer): The change in clause 160 was made to make it clear. Heretofore we specified the ultimate strength of the test piece. Now we specify the ultimate strength of the full-sized eye-bar and let the manufacturer determine the ultimate strength of the test piece, which will give the final results of the test bar as specified, 55,000 lbs. per sq. in.

Mr. Greiner: In clause 133 the committee would like to make a change in order to make this paragraph consistent with 160; we want to change the last part to read, "the manufacturer shall guarantee the bars to meet the requirements of paragraph 160." In paragraph 160 we want to say "bars shall generally break in the body," because we make provision later on unless more than one-third of it breaks it will not be cause for rejection.

Mr. Kelley: I want to ask the committee if there should not be necessary to limit it to such a narrow head as this not be necessary to limit it to such a narrow head as this would give if we cut out our ⅜-in. web.

Mr. Schneider: The change in that paragraph was intended to do away with the thin web plates which are used in specifications. A great many roads now limit the thickness of web plates to ½ in., like the Pennsylvania R. R. That is somewhat of a compromise move in the right direction.

Mr. Greiner: You should also take into consideration the fact that while we have many plate girders now with ⅜ and 5-16 web, a number of them were built for much lighter roads. The ⅜ webs are undoubtedly giving good service, even now for the lighter loads, but as we have increased the rivets and increased everything else, it is consistent to let the webs go

up with it. Unless we have some such limit as that there is nothing to prevent the engineers trying to fill the girders with something else.

C. S. Churchill (N. & W.): I want to refer back to 11ϑ, increase of load on masonry. It occurs to me that may be a step backward, due to the fact that impact loads are increasing. It is not strictly correct to say that sandstone and limestone bases are equal to granite.

Mr. Schneider: In the old speecifications we allowed higher pressure on concrete than on stone, and in most bridges the size of the bed plates is determined without knowing the size of the masonry.

Mr. Greiner: There was another reason: we wanted to be consistent with the Masonry Committee's recommendation.

The secretary read conclusion 1.

Mr. Fritch: Would the committee be willing to change the signs for tension and compression, minus for tension and plus for compression?

Mr. Greiner: Some of the committee have used minus for compression and plus for tension and others reverse them. But all the text books use plus for tension and minus for compression, and it has become the general practice.

Mr. Fritch: I think that every reason points to using the minus sign for tension.

Conclusion was adopted.

The secretary then read conclusion 2.

Mr. Greiner: This section has been under consideration for several years. The committee felt that rules for governing the inspection of bridges in the field should be carefully considered and expressed, and so far as possible in such manner as not to commit either this association or the individual roads which would use this rule to any great extent. Inspection of bridges must necessarily, of course, depend on the character of the bridges and the organization of the roads which control this inspection. This report is the report of the full committee, without dissension.

The secretary read that part of Appendix A to which this conclusion refers, and conclusion 2 was adopted.

J. P. Snow (B. & M.): Regarding conclusion 3, I think that a specification for this purpose should be pretty much in outline, concise and short, something similar to what the committee has given us in the way of directions for the care and inspection of existing bridges.

The subject of erection of bridges was referred back to the committee for further consideration.

Conclusion 4 was adopted.

Mr. Greiner: Regarding conclusion 5, I would like to ask some of the reinforced concrete men present what kind of a railway bridge they could construct of reinforced concrete in the shape of a slab for a span of 40 or 50 feet.

Mr. Condron: I have designed up to 30 feet.

Mr. Greiner: The committee feel that 40 feet is about the limit.

Conclusion 5 was adopted.

Prof. F. E. Turneaure (U. of Wis.): It would be impossible to read the whole report of the sub-committee on impact here, of course.

The following summary of results relates only to the series of tests which have been made by the sub-committee:

1. With track in good condition the chief cause of impact was found to be the unbalanced drivers of the locomotive. Such inequalities of track as existed on the structures tested were of little influence on impact on girder flanges and main truss members of spans exceeding 60 to 75 ft. in length.

2. When the rate of rotation of the locomotive drivers corresponds to the rate of vibration of the loaded structure, cumulative vibration is caused, which is the principal factor in producing impact in long spans. The speed of the train which produces this cumulative vibration is called the "critical speed." A speed in excess of the critical speed, as well as a speed below the critical speed, will cause vibrations of less amplitude than those caused at or near the critical speed.

3. The longer the span length, the slower is the critical speed and, therefore, the maximum impact on long spans will occur at slower speeds than on short spans.

4. For short spans, such that the critical speed is not reached by the moving train, the impact percentage tends to be constant so far as the effect of the counterbalance is concerned, but the effect of rough track and wheels becomes of greater importance for such spans.

5. The impact as determined by extensometer measurements on flanges and chord members of trusses is somewhat greater than the percentages determined from measurements of deflection, but both values follow the same general law.

6. The maximum impact on web members (excepting hip verticals) occurs under the same conditions which cause maximum impact on chord members, and the percentages of impact for the two classes of members are practically the same.

7. The impact on stringers is about the same as on plate girder spans of the same length and the impact on floor beams and hip verticals is about the same as on plate girders of a span length equal to two panels.

8. The maximum impact percentage as determined by these tests is closely given by the formula:

$$I = \frac{100}{1 + \frac{l^2}{20,000}}$$

in which I = impact percentage and l = span length in feet.

9. The effect of differences of design was most noticeable with respect to differences in the bridge floors. An elastic floor, such as furnished by long ties supported on widely spaced stringers or a ballasted floor, have smoother curves than were obtained with more rigid floors. The results clearly indicated a cushioning effect with respect to impact due to open joints, rough wheels and similar causes. This cushioning effect was noticed on stringers, floor beams, hip verticals and short-span girders.

10. The effect of design upon impact percentage for main truss members was not sufficiently marked to enable conclusions to be drawn. The impact percentage here considered refers to variations in the axial stresses in the members, and does not relate to vibrations of members themselves.

11. The impact due to the rapid application of a load, assuming smooth track and balanced loads, is found to be, from both theoretical and experimental grounds, of no practical importance.

12. The impact caused by balanced compound and electric locomotives was very small and the vibrations caused under the loads were not cumulative.

13. The effect of rough and flat wheels was distinctly noticeable on floor beams, but not on truss members. Large impact was, however, caused in several cases by heavily loaded freight cars moving at high speeds.

The report includes photographs of typical curves illustrating various points of the report, diagrams of the impact percentages on all of the trusses, diagrams of maximum impact with the curves plotted thereon, and sheets of data. The original diagrams are all filed now in the secretary's office, where they can be inspected by any one interested.

The future work of the committee, so far as it has been planned, includes some additional work on spans exceeding 300 ft., and, if practicable, on very short spans. It has been found very difficult to devise an instrument which will be entirely satisfactory for spans 20 or 30 ft. in length, but if that can be done it is very desirable to continue experiments on the very short spans.

The President. I am sure you will agree with me that we have some very valuable information before us in this particular form, and it will be in print as early as possible and you will all receive a copy of it.

Mr. Greiner: I move that this report on impacts be accepted as a progress report, although it is almost complete, and that the committee be continued with instructions to make further investigations on impacts on long spans and very short spans and also on the investigation of secondary stresses.

Mr. McDonald: I would add that concrete slabs be included.

Mr. Greiner: That was our intention.

The sub-committee report on the allowable length of flat spots on car wheels and the effect of flat spots on car wheels on bridge structures was accecpted as a progress report, with instructions to the committee to continue their investigation.

Discussion on Wooden Bridges and Trestles.

Mr. Condron: Referring to the revised specifications for metal details used in wooden bridges and trestles (Appendix A). I notice it reads "if made by the acid process it shall contain not more than 0.08 per cent. phosphorus." The other committee changed it to 0.06.

Prof Jacoby: The idea is to have it in perfect harmony. It is understood that change will be made here.

The proposed amendments relating to the specifications to be covered in the Manual were adopted.

Prof. Jacoby: Turning to Appendix B, these specifications were adopted almost exactly in the form in which they appear here at our meeting last year. At that time the titles for the two grades of yellow pine were given as Railroad Grade and Falsework Grade, but at the meeting of the Yellow Pine Manufacturers' association these titles, although agreed to by its committee, were not favorably considered. Hence in consultation with our sub-committee, which was present at that meeting, it was agreed to substitute the terms Standard

Heart Grade for the long leaf yellow pine, and Standard Grade for the long-leaf and short-leaf yellow pine, in the two grades included. One addition was made. In connection with the next specifications which we will take up on Douglas fir and Western hemlock, the term "full length" was necessary, and it was considered desirable to add this term also in these specifications. This has been agreed to by the committee of the Yellow Pine Manufacturers' association and the committee for the American Society for Testing Materials, and the word "corner" has been substituted for "edge" to conform with the trade terms. It does not, however, change what has already been adopted in any other particular.

Mr. Fritch: In the Standard Grade there is provision for ties and guard timbers.

Prof. Jacoby: It was not intended to include that.

Mr. Fritch: It seems to me ties and guard timbers should be covered, because we may want to use standard grade on inferior lines.

W. H. Courtenay (L. & N.): I would like to see the knot specification limited a little. I think the specification admits too large knots in stringers and also in taps and sills. It would seem to me preferable to merely say that no loose or unsound knots be accepted. That is a fair specification in the yellow pine district, but I fear with this specification as to knots we would get a good deal of bad stuff; you frequently find yellow pine with the grain running across the stringer, and such material is weak and should be rejected.

Prof. Jacoby: The specification in detail was gone over at the last meeting and adopted in the form in which it is here presented, with the exception of a few minor matters which are to be adjusted, and it is now brought forward simply for the purpose of receiving the approval of the association so far as these few modifications are concerned in order that it may be printed in proper form in the Manual.

Mr. Fritch: I move that a clause be inserted in the specification for standard grade long-leaf and short-leaf yellow pine, covering ties and guard timbers.

Mr. Courtenay: A railway company would not want yellow pine ties and guard rails according to the specification for standard grade for anything except temporary purposes. The sap rots very rapidly on yellow pine.

L. J. Hotchkiss (C. B. & Q.): It was the idea of the committee in considering these specifications that such timber as is included under the standard grade would only be used for temporary construction, falsework and construction of that sort; for that reason these timbers were omitted and included only in the standard heart grade.

M. A. Neville (P. & E.): In reply to Mr. Fritch's remark, the practice where I have been, under these circumstances, has been to use a first-class tie and figure on reusing it for some other purpose after it has served the temporary purpose, because the ties need not be handled so that they could not be again used. The inferior timber you would get under this secondary specification would not be of any account after you used it temporarily in falsework. We always used the better class of ties and guard rails, and figure on getting our money back in using them again in another place.

Mr. Snow: It does not seem to me consistent for this committee to specify the use of poor material you can always use poor material if you want to.

Mr. Fritch: There are a lot of places where you have trestles for industrial track, where you are not justified in using first-grade stuff and second-grade stuff would give all the service required.

Appendix B was adopted.

Mr. Fritch: I think the terms Standard Heart Grade and Standard Grade are unfortunate. In the first place, we here use the term "Standard Grade" for inferior material. It seems to me that there is great opportunity for making errors in the requisitions. If you leave out the word "heart" you get an inferior grade of material. I suggest instead the terms "Standard Heart Grade" and "Second Grade."

Prof. Jacoby: The matter of terms has been taken up for several years in the meetings of the three committees—the Yellow Pine Manufacturers' association, the American Society for Testing Material and the committee of this association, and it has been exceedingly difficult to get terms which will be satisfactory to the manufacturers. They will not consider for a moment the use of the term "Second Grade," because of its confusion with that term as employed in the trade in other ways. Last year we had a second meeting after our report was adopted and we came in the next morning after further consultation and substituted for "Railroad No. 1" and "Railroad No. 2" the terms "Railroad Heart Grade" and "Falsework Grade." When we came before the Yellow Pine Manufacturers' association they refused to adopt that, and the three committees agreed on these terms as the best that could be secured at present. Possibly in the future better names may be agreed on.

Mr. Snow: I am in considerable sympathy with Mr. Fritch's remarks. I do not think that term is a good one. Has the committee tried the term "Merchantable" with the manufacturers?

Prof. Jacoby: We are glad to receive the suggestion.

Sections 1 and 2 of Appendix C, were adopted.

Mr. Fritch: I desire to go back to Appendix B and call attention to the fact that the word "live" is left out of the general requirements. Is that intentional?

Prof. Jacoby: It was pointed out to members of the committe by those who had experience with the Douglas firm that it was very much more important that it be included in this specification than in the specification for yellow pine, and it was thought the wisest course to have it included definitely in this place; that dead Douglas fir was much more seriously to be considered than in the case of yellow pine.

Sections 3 to 8, inclusive, of Appendix C, were adopted.

W. K. Hatt (Purdue Univ.): As to the name of that inferior grade, my understanding is that the manufacturers will not object to the term No. 2, or Merchantable, but that the objection has come from the members of this association. I think the term "Merchantable" is better, as the members of Committee Q say that the members of the association do not care to acknowledge that they have any second class material in their tracks.

The President: I think the members of the Yellow Pine Manufacturers Association strenuously objected to the use of the term No. 2, and gave us a number of reasons for doing so.

Clauses 9 and 10 were adopted.

Mr. Fritch: I do not think we ought to pass over these names Standard Heart Grade and Standard Grade without fixing them definitely. We can all see how easy it is to make up a requisition and leave out the word "heart" and have a lot of material on the ground which would be expensive for us. It seems to me if we would use the word "merchantable" instead of "standard grade" it would lessen the possibility of error. I move that the words "standard grades" be changed to "merchantable grades."

Mr. Osgood: I will ask if there is any danger of a conflict. In some kinds of timber the manufacturers have a merchantable grade. I do not know whether that is the case in this Western country or not. But if they do have such a program it might be very confusing to have a merchantable grade for the association and also a merchantable grade of the manufacturer.

Mr. Fritch: I think the specifications will fix that.

O. E. Selby (C. C. C. & St. L.): I think the term "heart grade," should be retained. It is disinctive and shows the quality most desired in that kind of timber. The term "standard grade" is not distinctive, but it is not objectionable to anybody. The term "merchantable grade" is a trade term that I think should be left out of the proceedings of this body. It is a common trade term and if adopted here would be confused with other "merchantable" terms adopted by manufacturers associations. It seems to me that the object suggested by Mr. Fritch, the possibility of confusion in the specifications on the requisitions and orders, could be obtained by omitting the word "standard" from the first grade, calling that heart grade and retaining the word standard for the second grade, calling that standard grade. I move to amend by making that substitution.

Mr. Jacoby: There might not be a serious objection to the term, so far as it relates to Western hemlock, but I do not think it desirable to make any change in the previous specifications for yellow pine, because, in accordance with the instructions of the association the committee has been endeavoring for three years to bring about absolute uniformity between the three associations. The specifications in the form in which they are printed here have been published and extensively circulated throughout the country in pamphlet form, and it is desirable that these should be given a thorough test, and then if any modifications be found desirable they can be brought up in subsequent revision. We feel we have done the best possible to secure this result, and we do not believe it would be wise to change the terms at present. This specification in its present form has been adopted by the American Society for Testing Materials and the Yellow Pine Manufacturers Associations. Of course, any suggestions to be offered can be taken up and considered in the consultations with the conference committees, and we shall be very glad to do what we can.

Mr. Fritch: I withdraw the motion, with the understanding that it will be taken up with the Yellow Pine Manufacturers Association and see if they can harmonize on terms that are not confusing.

Mr. Selby: I move that the term " standard" be dropped from our grades; that the first grade be called "heart grade" and the second grade be called "standard grade."

The motion was lost. Conclusion 2 was adopted.

Mr. Jacoby: It was suggested that we add to the definitions of structural timber, as printed in Appendix B the definition of full lengths, long enough to square up to the lengths specified in the order.

Conclusion 3 was adopted, with the change suggested.

Conclusion 4 was adopted.

Discussion on Rail.

Mr. Churchill: The only item of work we regard as completed is No. 4, presenting the report showing diagrams and photographs of typical characteristic rail failures. The photographs of the rails which were published in bulletin 116, page 66, we would like to present and have them considered as a conclusion of that subject, excepting that the special cases that come up from time to time will be treated of as such where they will give information. But as for making another special report on that subject, we think it unnecessary.

In drawing up specifications we have had before us one main point: that we shall determine the quality of the rail not so much by prescribing details of manufacture as by establishing some tests that will determine whether the rail output is good or not.

As to conclusions, the results so far obtained from the heavy base A. R. A. sections are disappointing. We have received from the mills some rails of the new section which were as bad as those from the old A. S. C. E. section, showing that the quality of the rail does not depend upon the section.

The Vice-President: If there is no objection, we will adopt the committee's recommendation with regard to rail failures.

Mr. Churchill: As to the amendment of paragraph 5, that is the practice of the mills today, and has been ever since the drop-testing machine was put in use.

Conclusions 1, 2 and 3 were adopted.

Mr. Churchill: Conclusion refers to the specifications for Bessemer and open hearth rails. The original specifications were printed in Bulletin 118. Those specifications were printed in this bulletin early in December and were sent to the Manufacturers' Committtee. As the result of meetings with that committee we made slight modifications of this specification, which have just been published in this little pamphlet.

[The changes referred to may be summarized as follows: In article 2, the weight of lighter rails for which the composition is specified are limited to 70 lbs and over, but under 85 lbs. The allowable manganese content was changed to 0.80 to 1.10 for Bessemer 85 to 100-lb. rails; 0.70 to 1.00 for all open-hearth rails. The allowable silicon content was changed to 0.07 to 0.20 for all rails. In article 3, the limit below which the phosphorus content must be reduced to require an increase in carbon, is 0.08 for Bessemer and 0.03 for open-hearth rails. The requirement concerning the average percentages in an entire order of rails was limited to carbon. In article 4 the specification as to the amount of metal to be sheared from the end of the bloom formed from the top of the ingot is that the entire face shall show sound metal. In article 5 the shrinkage allowance permitted is made 6⅛ in. for A. S. C. E. sections and 6½ in. thick base sections. In article 8, shorter lengths to be accepted are allowed to vary by 1 ft. from 32 ft. to 25 ft. In article 9, the variation from a straight line, after hot, straightening is allowed to be 5 in. for A. S. C. E. section and 4 in. for thick base sections. In article 11 the following sentence is added: "All marking of rails shall be done so effectively that the marks may be read as long as the rails are in service." In article 12 (a), 60-lb. rails are omitted from the paragraph referring to the height of fall of the trip in drop tests. In article 16, the question of what rails contain physical defects which impair their strength is not specifically left to the judgment of the inspector; it is simply specified that any such rails shall be rejected.]

Article 1 of this revised specification was adopted.

The secretary read article 2.

Mr. Rhea: It is a well-known fact that the rail which we get is vastly different from the analysis of the test ingot. In taking this up with the manufacturers, I have found this difficulty. We have been endeavoring to get an open-hearth rail that would come within certain limits. If our specifications are so run that we are tied down to the chemical analysis of the test ingot, we cannot throw out the rails regardless of what the chemical composition of the rail is. Now, the manufacturer tells you that they cannot guarantee anything in the rail, and all they can do is to guarantee that the test ingot will be within certain chemical limits. I have found in actual practice that in one or two cases, under stringent conditions, we were able to get open-hearth rails within certain limits; that is, the analysis on the rail itself. Now, the point I make is that we should have something to definitely limit the chemical analysis of the rail itself. The specification plainly says it must be within the limit by analysis of the test ingot. I realize that you cannot test the rail before it is rolled. This test must be upon the ingot. You must test the ingot in order to tell how the rail is coming, but I think we ought to have something in the specification which will guarantee us within certain limits of the rail itself. In connection with this the last paragraph of article 3 comes in: "The percentage of carbon in an entire order of rails shall average as high as the mean percentage between the upper and lower limits." If you undertake to get a rail according to that specification, I presume that article would refer to the analysis of the ingot. If so, it should plainly state that, because you cannot tie yourself down to the analysis of the ingot in one place and state the analysis of the rail in another.

Mr. Osgood: We have found a great difference between the specification of the steel and what we actually got in the rail. I would also ask why it is the limit of carbon of the rail has been placed as low as 76, as a maximum for a hundred pound rail.

Mr. Churchill: As to the first point, we do not find as much variation as the gentleman has mentioned. The reports that we have been receiving show rails that do come within these limits. On the other hand, if there is segregation of material or other defects in the rail, then we will find the chemical analysis will run up out of reason, and it is those defects we wish to detect by tests. We cannot stop the rolling mills to take analysis of individual rails, and I think the gentleman will concede that. We have a right to take those tests if we choose, and the mill people have, before these specifications were talked of, even, taken rails back when complaints were made by the different railway companies, when defects were found and the material did not come within the specification.

As to the amount of carbon in open-hearth rails, we have attempted to provide for that to some extent in article 3. If the phosphorus runs down and is condensed, then the carbon can be increased. We think that 0.76 is about as high as we wanted to go with safety for an open-hearth rail with 0.04 phosphorus. I want to call attention right here to the fact that we have cut these specifications into only two classes of chemical content, which has never been done before. We think that entirely too much weight has been placed upon little variations in chemistry, and what we want more particularly is to find out what we are getting in the rails by testing the rails, just as we examine bridge materials; we don't prescribe minutely the chemical contents of all the steel that goes in our bridges. There are only a few limiting features. We think that we can get rails the same way, if we can make the tests on the finished product.

G. J. Ray (C. I. & L.): I think we should include in our specifications a clause to the effect that the chemical analysis of the rail itself shall be within certain limits. If the manufacturer cannot guarantee our rail within a limit of thirteen points, which is given in this specification for carbon, he ought to guarantee it within fifteen points. There is certainly some limit which should be set. The point I make is this: The rail itself, the carbon in it, may vary from fifteen to eighteen, or twenty. Careful analyses we have made on rails run from one heat to another show conclusively that the rail does not run within the limit which the test ingot was supposed to run. As a matter of fact, in these tests we have found that the test ingot and the rail itself run reasonably close, so that if care is taken in the matter of the manufacture of the rail, the rail can be rolled within certain limits. The rails purchased by the majority of the companies are in the track before the tests given them by the manufacturer are checked. We should have something specifically stating the limit in the rail itself.

The Vice-President: Don't you think the committee has endeavored to do that?

Mr. Ray: No, they do not. They say that the chemical composition of the steel from which the rails are rolled shall be within the following limits. There is nothing in this specification from one end to the other which shows the chemical analysis of the rolled rail. If you take the specification of any manufacturer in the country, he will not guarantee to roll

the rail and have it in accord with the specifications covering the chemical composition of the steel.

The Vice-President: You refer to the entire contents other than the carbon?

Mr. Ray: The carbon. But is is the case with all the composition.

T. H. Johnson (Penna. R. R.): I do not think the last speaker has ever studied any of the well-known analyses of different compositions in the ingot. Whatever the chemistry of the different elements of the ingot may be, no two rails rolled from the same ingot will show the same analysis, neither will test pieces taken from different forgings of a section of any one rail show the same analysis. To make a special provision covering the chemistry in the finished rail is simply an impossibility, and you could not carry it out.

Mr. Ray: I know very well that no two rails of any one ingot will show the same analysis. I have had several hundred of them analyzed the last season, all sections and all parts of the rail, and I know that is true. The point I make is that there should be some limit within which the rolled rail should come, and if it cannot be within thirteen points, it should be within something else. I cannot see how you are going to decide on the analysis of the ingot and let the rail go. You must analyze the rails, and if you do, you will find they are not anywhere near the chemical analysis of the ingot. You have no come-back whatever on the manufacturer. It is care in the manufacturing of rails that will make better rails. It is going to take more care to make the rails within certain limits, and that is what we ought to have.

W. C. Cushing (Penna. R. R.): The Pennsylvania Lines West this year are getting 75,000 tons of rail and we are having a regular checking analysis of the rail steel made after receiving the analysis of the metal from which the rails are rolled. In no instance have we found any where the check falls behind, and they check within reasonable limits of the analysis furnished by the mill of the metal from which the rail is rolled. And it would be an impossibility for any mill to guarantee how close it is going to come, but by continually watching, which is the duty of the customer, he can easily catch up defects which may occur. We have failed to find any case yet where it was necessary to take that up, and no one can guarantee what may happen in segregated steel. On the whole there seems to be little difficulty in having the rail steels come within reasonable limits of the mill from which it is rolled, just as Mr. Johnson said. We, therefore, find no reason or necessity of putting in any such specifications or any such clause in the specifications, because it is something that no one would know how to handle and nobody could guarantee.

W. R. Webster (Con. Eng.): I move that clause 2 be accepted and that the matter of any additional requirements upon the finished rail be referred to the committee to give us its opinion next year, if it deems it advisable. It is a matter we cannot decide tonight and it is useless to take up the time to go at it.

Motion carried.

Article 3 was adopted.

The secretary read article 4.

Mr. McDonald: I would ask the committee what the view of the manufacturers is with reference to that.

Mr. Churchill: The manufacturers have agreed to that clause in this form.

Articles 4, 5, 6, 7 and 8 were adopted.

The secretary read article 9.

J. G. Sullivan (Can. Pac.): I would ask the committee if it would not consider a rail that cools straight within 3 in. or 3½ in. a better rail, less apt to be damaged in the gagging; also if they had any difficulty with the manufacturers agreeing to give them such a rail. We are getting such rails in Canada.

Mr. Churchill: I believe that we will be able to get a rail that cools straight within 3½ in. from a great many mills. But many mills say they cannot do it at present. It is to the interest of the mill men themselves to get it as low as they can; and we have made the difference 4 inches for one type of rail and 5 for the other because the the thin base rail will cool less straight than the thick base rail and we are very certain that all mills will come well within that figure.

We hardly think it is to the advantage of the purchaser to put in the hands of the inspector a small detail such as a half inch or an inch variation from a straight line as a basis for condemning a rail, in view of all of these facts.

Articles 9, 10 and 11 were adopted.

The secretary read section 12 (a).

Mr. Sullivan: The committee has made a distinction in the chemistry of the rail between the Bessemer and the open hearth, but they make no distinction in the drop test. We are getting out some rails at present, and wherever we have a rather rigid drop test the mills are not complaining about the test on the open hearth, but they are complaining about the drop test on the Bessemer, even although we make a difference of 2 ft. in the drop. There is one other point I note the committee has not touched. I presume it is conceded that the drop test is to test the chemistry, as it were. If the chemistry is correct there would probably be no necessity for the drop test. The point that a gentleman brought out about the chemistry of the rail might, I think, be partially covered so far as the physical test could be made by putting limits in a deflection that you would get in the drop. We are doing that at present, that is, putting a minimum and maximum limit to which the rail would deflect. If you have such limits it seems to me you are getting a test on the hardness of your rail.

Mr. Churchill: The committee intends doing that. In section 12 (b) as you will see.

Mr. Sullivan: What we are depending upon for our hardness is this, if your rail don't break, but bends, in 3 ft. or 4 ft. whatever your requirements are, it would be deemed as being a rail too soft. If, on the other hand, it only showed a deflection of one inch which would be required, that would be an evidence of the rail being too hard.

Mr. Chuchill: That is just exactly the object of our committee. We do not have enough information before us to determine those figures. We have a very good idea of what those figures should be, but we prefer not to put them in the specifications now.

Mr. Sullivan: We would have changed recently to a three foot space instead of four feet, but we had data for the last ten years for four feet, so we retained four feet in order to be able to put that factor in our specifications.

Articles 12, 13 and 14 were adopted.

The secretary read article 15.

W. H .Courtenay (L. & N.): I would like to inquire why the word "injurious" is used there.

Mr. Churchill: We think defects such as small bends would not be injurious or make them defective for use on track. On the other hand, if the defects are of a larger character, a bad nick, a deep one or any defect whatever—we made this very sweeping—or any defect whatever discovered by the inspector, or a flaw of any kind that will render the rail unsafe, it is to be discarded.

Mr. Courtenay: It might be a flaw only an eighth of an inch deep, and the question might arise whether that is an injurious flaw or defect. On the other hand, that flaw might be a quarter or three-quarters of an inch deep.

Mr. Churchill: That we must leave, I think, to our inspectors. One class of specifications describe how deep a nick or flaw shall be to be rejected. This committee thought best not to go into detail. We think we have inspectors that are around mills constantly who are able to decide those questions at the mill. A flaw an eighth of an inch deep would be injurious in certain places, but a quarter of an inch flaw in other places might not be injurious.

Mr. Courtenay: The point is whether, when there is a slight defect in the rail due to pipe or air bubble, such rail is to be accepted or not.

The Vice-President: It is to be rejected.

Mr. Courtenay: It strikes me in this specification, that a slight flaw due to an air bubble in the ingot, and apparently running in one-eighth of an inch, might vary from nothing at all to a very grave defect, and it seems to me it would materially strengthen the specification if that word "injurious" would be eliminated.

Mr. Johnson: I think the gentleman wholly misapprehends the meaning of that particular sentence. That relates to superficial defects. Defects due to an air bubble or pipe are interior and never show on the surface. In the surface defects, they are defects which occur as the rail goes through the roll. They may be due to a flaw which makes a fault in the surface, similar to a nick. It does not matter whether it is one-eighth inch or one-half inch deep, it is equally dangerous. It may be due to a piece of cinder adhering to the roll, which merely makes a deficiency in the contour of the rail, which is harmless. It is that type of defect which that paragraph covers.

Mr. Courtenay: Twenty-six years ago I inspected many rails at the mills. That species of flaw which begins at the outer corner of the rail head and runs in will vary from nothing until it becomes a very great defect. At that time it was a question with me, as an inspector, when these flaws were extremely slight, whether I should reject the

rails, or whether they should only be rejected when the flaws became somewhat greater. There was a difference of opinion between myself and the mill authorities at that time, and we still get rails occasionally which are accepted by our inspectors as first quality rails that have these very slight flaws, and it is a question whether the inspector overlooked the slight flaws or knowingly passed them. I am of the opinion that a rail with a very slight flaw of that character is much more liable to break than a rail with no possibility of flaw whatever, and it would seem to me that a flaw of that type should be sufficient to reject the rail even though it may be very small. For that reason I make the inquiry about the word "injurious," whether it is the opinion of the committee that these extremely slight flaws, when of the same general character that sometimes run one-quarter inch, one-half inch and three-quarter inch from the gage edge of the rail, should be sufficient cause for throwing a rail into the second quality class.

The Vice-President: If you eliminate the word "injurious" then a rail must not have any defect or flaw of any kind on the surface.

Mr. Courtenay: I would not call a mechanical dent in the head of the rail a defect at all. Neither would I call a scrape along the head of the rail a defect, due to the fact that while the rail was hot, it got a little askew with the guide of the rails and got scraped.

The Vice-President: That is what the committee intends to cover. It does not refer to any interior imperfections, but imperfections on the surface only.

Mr. Courtenay: The point seems of some importance, because it strikes me that with this specification you might have a flaw, and although its outward appearance on the rail may seem to be very unimportant, it is of the same general character and induced by the same causes as interior flaws.

The Vice-President: Then, no matter if the defect were of no consequence, it would reject that rail as number 1.

Mr. Courtenay: I would not include mechanical indentations; that is not a flaw.

Mr. Snow: It seems to me the way in which this clause is written covers the gentleman's case exactly. If he discovers these very slight flaws he speaks of and considers them injurious, as he says he does, and he thinks the rail would be liable to break at that point, it certainly then becomes an injurious flaw in his judgment and he has a right to reject it. If we leave that out and make it free from all defects, then he has to throw out the rail if there is the slightest indentation, which he says does not hurt it any. I think it is better to leave it as it is.

Prof C. Frank Allen (Mass. Inst. Tech.): It says that rails shall be free from injurious defects and flaws of all kinds. Suppose the inspector thinks the defects are injurious and the representative of the rolling mill thinks they are not injurious, should there not be some statement in this clause as to whose decision shall govern it?

The Vice-President: The inspector should be the umpire in that case.

Prof. Allen: Should not the clause so state?

Mr. Webster: The inspectors as a general thing take care of that matter individually. I think that is a point that the committee might take under consideration and express their views upon the matter at the next meeting. I do not think it is right to ask the committee to change any part of their specification unless they do so willingly, and therefore I move that the clause as it now reads be accepted, and that they give us their views as to the different classes of flaws, if they have any remarks to make on them, next year.

Mr. Churchill: We will consider that next year.

Mr. Churchill read clause 16.

Mr. Downs: Nothing is said about loading, except that they shall be loaded in the presence of an inspector. I have known of mills damaging rails while loading them, loading the rails in coal cars, and the rails have been kinked after they have been loaded in the car. I think it would be well to have something in the specification on that point, and it should be specified who is responsible for the loading.

Mr. Churchill: It seems the fact that they are loading in the presence of an inspector makes them responsibe for their correct loading. That is the object of the reading.

Mr. Downs: I do not know whether that would cover it. It does not define what he shall do if they are loaded improperly.

Mr. Churchill: We think when we put an inspector on the ground and tell him he must see these rails properly loaded and shipped correctly, he is responsible.

Mr. Downs: I think it would be wiser to make it broader —to make it "carefully loaded" and not thrown on the cars. I have seen rails loaded at the mill which were injured and kinked after they have been loaded on the cars, because of their not being loaded properly.

Mr. Churchill: We have endeavored to make the wording precise and brief right through, and we believe that clause will do the work and get the results.

C. H. Stein (C. of N. J.): I notice that it specifies that No. 2 rails should have two prick punch marks on the side of the web, near the heat number near the end of the rail, so placed as not to be covered by the splice bars. It seems to me that the use of the words "near the end of the rail" are unnecessary, because the heat number is not always near the end of the rail. I have seen many places where it was right in the center of the rail.

T. H. Johnson (Pennsylvania Lines): I would like to ask the last speaker what mills those rails were from. In all the mills the committee visited, we haven't seen any mill that had the practice of making the heat number in the middle of the rail.

Prof. Allen: In relation to one of the objections made, that all rails shall be loaded in the presence of the inspector, would there be any objection to making that read: "All rails shall be loaded in the presence of the inspector and to his satisfaction."

Mr. Stein: The committee visited four different mills. Now, in examining quite a number of tons of rail from one of those mills I never saw the heat number missed in a single instance. There was not a single instance in which that heat number was not at the two ends of the rails. With two of the other mills specified here, I found the heat number in the center of the rail, and in the case I particularly referred to, I found it invariably at the center of the rail, and in a great many of the rails I examined I didn't find it in a single case anywhere but at the center of the rail.

Mr. Churchill: We expect to get better results in marking the rails than ever before. Committee A has that up with the manufacturers now, to get all the mills to be more systematic in branding, and we think that article 11, taken in connection with this one, will get that up and put the marks at the branding point or the heat number nearest to the end of the rail, and therefore easiest to find. We will take up the question as to the satisfaction of the inspector next year.

Prof. Allen: It would be desirable in the specifications, if you can, to say distinctly what is meant. No. 15 reads that it shall be free from injurious defects and flaws of all kinds, to the satisfaction of the inspector. That makes it absolutely definite, and there is no question as to who shall determine the injurious quality of the defect.

The Vice-President: The committee feels that adding a word of that kind is superfluous; that these specifications are supposed to be to the satisfaction of the inspector, or they would not be drawn.

Mr. Courtenay: The Louisville & Nashville has had a great deal of trouble getting its rails loaded properly. They dump them over the side of the car and let them fall any way they may. The mills have given a variety of excuses. Instead of having one rail laid head up and the next head down, we have frequently had them thrown in promiscuously. We have complained to the inspector and the mill both.

Mr. Cushing: I can offer some explanation of trouble of that kind. That occurred in our case, and in making investigation at the mill we found improper loading always occurred in the case of cars that were too short. They are cars that the rail absolutely filled up. There was scarcely any margin of length between the end of the rail and the car, and the mills pointed out and showed to us conclusively that they could not load the rail in cars of that kind in the way that the railway companies wanted. But when the cars were furnished of proper length, with a foot or two of margin between the ends, the men were able to get in and properly load them. I think you will find all mills are willing to do the same thing without saying anything about it in the specifications.

Robert Trimble (Penna. Lines): Our investigation showed that nearly all the mills now are putting in improved loading devices, so that with short cars they will be able to load them properly.

Mr. Webster: I would like to ask some of the speakers who have expressed themselves about extra care that should be taken in loading the rails, if they will say what care shall be taken in unloading the rails, so as to avoid injury? If you will add that I will move that those sections be adopted.

The Vice-President: I think Mr. Webster has touched the sore spot.

The secretary then read article 17 (a) and (b).

Conclusion 4 of the report was then adopted.

Conclusion 5 was adopted.

Mr. Cushing: Now, the plan of the committee is that hereafter the date will remain the same, October 31, but that some time will be taken for receiving and collecting and digesting the report, and that no attempt will be made to have those statistics printed in a bulletin before the convention; they will follow shortly after the convention, and be ready for the proceedings; and if the association desires to act formally on those statistics it will be done by letter ballot instead of on the floor of the house as at present, as there is usually little to discuss in these statistics; they are for the purpose of study rather than discussion; and it seems to us that that will be sufficient. We would like to have that plan hereafter approved by the association instead of attempting to rush them through and omitting a lot of valuable reports in order to get them out in time.

The first two sets of reports that were published did not contain very many remarks in regard to them, but as the statistics became a little more perfect, we have given some thought obtained from a study of the last collection on page 10. It is not the intention to act on this, but just to call your attention to them and give you an idea of what we think these statistics accomplish: First: the study of these general statistics does not furnish accurate and specific information so as to determine the value of different sections of rail because the conditions of traffic are different, the conditions of road-bed are different, and the conditions of ingot making and rolling practice are so different that the quality of the material varies widely, and this difference in quality of material eliminates difference in section. Second: The study of these general statistics, however, tends to disclose unusual results. Third: The general statistics are also important in showing the relation between broken rails and failure of heads, web and base.

Unless they hereafter bring out something else, that seems to be the most we can get out of them. They have been not only tabulated, but tables or diagrams have been made with the attempt to make those comparisons which I have mentioned. But in looking through those diagrams you won't be able to tell whether heavy base rails are better than light base rails or whether high section rails are better than low section rails. You can think out most any result from those and it comes too largely from the conditions I have mentioned, and from the fact that the periods of the rails in the track are different. It is well shown by these diagrams that most of the rail failures occur in the first four years of the life of the rail, but we continue to receive reports from those particular tonnages of the rail all through their life and I think there are fewer failures toward the latter part than toward the beginning. Therefore the same age of rail does not always compare; but we think we can get some very general ideas from the information.

The association is requested to approve of a change in a few of the forms which have been used for collecting rail failure statistics, because in making these up we have found changes desirable, and as this is a time for printing the manual, we would like to have them as complete as possible before they go in. This information is given on page 11, Bulletin 121. The main change is in Form 2002-A: "Report of Rail Failure in Main Tracks." And it is desired to change the unit for comparison from percentage as heretofore in the blanks to appear on failures from 10,000 tons. The same unit will then be used for the diagrams and for the tabulated statement. At the present time, two units are used, one for the diagram and one for the general statement. Our experience leads us to believe that the diagram unit is the preferable and that is the object in requesting the change in these forms. Form 2002-B naturally follows from 2002-A. The change in the laboratory report is simply a correction in the headings, introducing the words "per square inch," omitted in the former report. That is 2003-A. And the only remaining change is 2004-D, "Position in ingot of steel rail."

The changes in these forms, as recommended, were approved.

J. A. Atwood (P. & L. E.): Regarding the further plans of the committee arrangements have been made for manufacturing a certain number of rails by the Cambria Steel Co., the Lackawanna Steel Co., the Maryland Steel Co., the United States Steel Co., the Pennsylvania Steel Co. and the Bethlehem Steel Co. Some will be open hearth and some Bessemer. These rails are to be tested chemically, physically and possibly on the revolving machine of the Pennsylvania Steel Co. and on a machine which the Maryland Steel Co. has built for testing the ability of a rail to resist crushing. These rails will also be tested in the track test, and a certain number of them will also be tested in service. This series of tests will take a long time, but we may have some results to present at the meeting next year. We have engaged Mr. Wickhorst of the C., B. & Q., to assist us in this respect in looking after these tests. He will give his personal attention to the making of these tests and to the guiding and directing of the committee and assisting the committee in every way he can.

We have made, as you know, several tests of rail joints at the Watertown Arsenal. The result of those tests have been tabulated and will be presented in a Bulletin to be published shortly. Drop tests which have been made at the Maryland Steel Co. have already been printed in bulletins. This covers, I believe, in a general way the actual tests which Committee A has had under way.

Mr. Churchill: I don't want to have the association think that we have agreed in every little detail with the Manufacturers' Committee but we have gotten together as closely as we can, and we have obtained substantial agreements on the greater part of these specifications.

The paper by J. W. Kendrick (A. T. & S. F.) on Conservation of Cross Ties by Means of Protection from Mechanical Wear was then presented by the author and illustrated by lantern slides. This paper is published in another column.

UNIFORM SIGNALING.

A. H. Rudd (Penna. R. R.) chairman of the Committee on Signals and Interlocking, presented the following answer to the minority report of that committee during the discussion of the report:

The committee believes that its report on uniform signaling fully covers the subject and has no additions or further explanations to make. The minority report sets forth certain objections and it is our belief that time will be saved if an opportunity is given the committee to answer these objections of the minority (which has studied the subject probably more carefully than any member outside the committee) as, if we can dispose of them, the way will be cleared for action. The following page numbers refer to pages in Bulletin 119, in which the majority and minority reports were published:

Page 71. It is unfortunate that the minority included paragraphs (a) and (b) in a report to this broad gage association. The statements are really not arguments, for if the system is a good one, the official titles of its sponsors cannot injure it, and if it cannot be commended, no such titles should be used to bolster it up—it should stand or fall on its merits. However, the statements have been made and as they carried considerable weight in the Signal association, and as they possibly affected some votes of that letter ballot (which resulted in 235 votes for the report and 311 against it, while two-thirds vote was necessary for adoption), it devolves upon us to answer them despite our embarrassment, for it now becomes necessary to tell you what a wonderfully well equipped body of experts we are—a fact which should be self-evident to all men of discrimination, but upon which the minority casts a doubt. We apprehend that a chief engineer approving designs for a classification yard has glimmerings at least that it is to be used for the passing through it of cars, and from some of the discussion had here on the subject of momentum grades, for example, it is to be presumed that some engineers at least know something about the requirements of the transportation man; similarly it is fair to suppose that a well-equipped signal engineer must of necessity understand the requirements of the traffic he facilitates and safeguards, and as he makes a specialty of this work, that he is better fitted if he understand his business, to devise a uniform system of signals, than a superintendent, whose desire is to attain certain ends and whose study of the means to attain these ends must perforce in most case be perfunctory; although it cannot be denied that under the spur of the discussions in this and the Signal association some superintendents have given the subject more thought in the past four years than all the superintendents on all the roads ever gave it before. I do not wish to be understood as implying that our honored vice-chairman is disqualified as an expert because he has become a superintendent. We claim that this committee is made up of just such well equipped competent signal engineers as those referred to and we offer ourselves as living proofs of the statement. This committee is composed as follows: Of men who make, or have made until recently, a special study of signaling, majority 14, minority 2; operating men, on whom such stress is laid, majority 3, minority 3; one not signing either report, engineering in close touch with operation, majority 1. These men do not represent any roads or systems in this voluntary organization;

they represent their own individuality, untrammeled by instructions of their operating officers, superior officers or any one else. It is true that the Pennsylvania has two men on the committee, the Baltimore & Ohio, two, and the New York Central Lines five, but the fact that these five happen to be employed on the component parts of a great system, which parts have different practices, does not warrant the implication of prejudice and certainly a responsible position on the New York Central Lines is not prima facie evidence of mental disability or lack of knowledge, or judgment—in fact, these are the men who are best qualified to design a uniform system, because they have to deal with the complicated as well as the simple problems of track layouts and signaling. The Pennsylvania Railroad, for instance, has problems in no whit different from those of the western signal engineers. We have approximately, 456 miles of four-track, 110 miles of three-track, 1,230 miles of two-track line, a total of 1,786 miles, and 3,500 miles of single track—two-thirds of our mileage is single track. And, on 445 miles of this we had, a year ago, only from 2 to 10 movements daily and on 525 miles more, from 11 to 18 movements daily. It is true that there is less four-track west of Chicago than east of it, but the western roads are growing and they will soon be confronted with the problems which are now vexing many of the majority members and will appreciate more fully the need of the information we propose to give, and this problem covers the whole coun —no east and west issue should be brought into it; and, in fact, some of the busiest four-track road is right around Chicago—and they give in a different way just these very indications.

It will be noted that the minority offers no substitute scheme, but confines itself to criticising. Last year Mr. Stevens presented a scheme and it was illustrated in the Proceedings. Mr. Clausen presented a scheme to the committee, this scheme being discussed at the Signal association last March. Neither of these schemes met the approval of your committee. It is fair to suppose these schemes were in the minds of the minority when its report was made. It states that our schemes represents the opinions of signal experts rather than those of men actually engaged in railway operation. Is this a fact? No road, to my knowledge, has adopted the basic principles of the scheme advocated by Mr. Stevens. If I am wrong he will be able to correct me later. No road, as far as I know, has adopted the fundamentals of Mr. Clausen's scheme, and it is in two or three fundamentals only that our differences lie. There is no difference of opinion as to the advisability of upper quadrant arms approved by this association, little, if any, on green for clear, approved by this association none on the automatic signal. The chief differences are on the use of the mid-position of the home signal arm instead of a second arm to indicate a divergence from the main track, the addition of a permissive indication for those roads who believe they require it, and the question whether the distant signal should be considered as giving the engineer a right to proceed to the home, expecting to find it clear. Is the vice-chairman's own road, which he implies he represents, using his mid-position for diverging routes on new work and renewals? On the other hand, the B. & O. is using the primary aspects recommended by the committee, except the use of green for clear; The New York Central operating officials have endorsed the committee's scheme; at least, to such an extent that they have adopted it for all new work and renewals, with little change. All the new interlockings on the L. S. & M. S. are arranged in this way, and the basis of the system is being used on many others; at least, this is my understanding. Transportation officers of the Pennsylvania Railroad, from general manager down, have, with few exceptions, endorsed practically all the primary aspects (and we have adopted 3-pos. upper-quadrant for new work and renewals on our lines east of Pittsburgh within the past week). Further, we are going to use automatic signals with one pointed arm and two lights staggered; the interlocking signals three-arm, with top arm for high speed, second arm for medium speed, and third arm for low speed; distant signals approaching interlockings will have two arms with staggered lights to correspond with the high medium speed arms on the interlocking signals; distant switch signals are to be of the one-arm automatic type. It would appear, therefore, that some operating officials of good standing approve the scheme.

Page 71. We believe that this argument is sufficiently answered in the body of the report under the caption "Object of the Report," except as reference is made to the American Railway Association. As that association has endorsed the upper-quadrant and made optional the use of green for clear, and has never made any rulings on the other principles enunciated in the report which are at variance with the recommendations of your committee, it is fair to suppose that if this system meets the approval of this association, it will have as much chance for adoption, if the A. R.-A. sees fit to recommend for adoption any uniform system, as some other which it has not been considered advisable by the minority to submit for your consideration. Certainly if this association should decide not to present any scheme to the A. R. A. for fear it might not approve it, the decision should be made of having annual reports presented on it.

Now, as to the seven specific objections:

Page 72. (a). The minority states: "The 45 degree position of the arm is at present used indiscriminately for caution signals, whether for distant signals, permissive signals or for some other purpose." This statement is perhaps a little misleading to those who are not experts. It is used perhaps indiscriminately on one or two roads for the distant signal indication and the permissive, but on a number of roads 45 degrees is used for the distant only (at least, in the new U. Q. installations), and on most other roads the day aspect for the distant signal at caution, is a fish-tail arm horizontal and the permissive a square end arm inclined downward or upward from the horizontal. So they are not used indiscriminately generally to-day. As to the some other purpose, the minority should amplify. We do not know of any instances where the 45-degree position of an ordinary semaphore signal is used, for instance, as a slow sign for track under repair, which requires caution, nor for diverging from the main track, as advocated in committee by the minority members, and we would be glad to be enlightened as to other purposes for which it is used. The committee recommends its use not as the minority states, for the distant signal indication only, but for the permissive as well, but it recommends a distinguishing mark when it is used for the latter indication, in order that the engineer may know whether he is to stop at a definite point ahead, or look out for a train in a long block moving at perhaps varying rates of speed. While it is true that very little discussion was had on this particular point in the full committee, it certainly had plenty in the sub-committee, and, further, little discussion was needed in the full committee, for, as the minority well states, it was (after consideration) "held by the majority as axiomatic."

(b) On page 57, you will note the indications presented in 1908, where routes were specified; the next year the word route was eliminated by the vice-chairman, who was given the task of correcting the table and bringing it into accord with his watchword, "The action required of the engineman in the control of his train." This year it appears that the original table was right. The revised table is now considered wrong. Ever since the top arm has led to the straight or through route at interlockings, it has, in the clear position, given the indication that the route was set up on which, unless prevented by some other cause, full speed could be maintained, and ever since that time the second arm has meant reduce speed, because the train was going to diverge. Some roads displayed indicators to designate the track and then discarded them. Some roads used three arms, the second arm to govern with traffic and the third against traffic; not because of routes to be shown, according to our analysis, but because they realized it was not safe to give the same signal for different rates of speed; in rare cases four arms were used, if there was a junction with three running tracks. I have never heard of a road having six or seven diverging routes, however, as a four-track joining a four-track, which used eight arms, signaling each route separately; the routes, as the minority say, were grouped, and not only common practice, but the action of this association, gives approval to the arrangement of the top arm for the high-speed route, second arm for medium-speed route or routes, and the third arm for low-speed route or routes, and if it will clear the atmosphere and simplify matters in the minds of any to add the word route, it can easily be done; the point in our minds is not important enough to require much discussion and we have followed the wording of the A. R. A. The statement that the assignment of arms has not had full discussion in full committee depends for its accuracy on the definition of the word full. The location of arms was discussed in connection with Mr. Stevens' scheme, at the signal meeting last March, and at the meeting of the committee in Philadelphia, at which Mr. Stevens was present. To the best of the chairman's knowledge, both of these matters have been open for discussion at all times in the committee meetings. If they have not had full discussion, the reason is, it is believed, that most of the members were convinced of their correctness and were not disposed to join in prolonged discussion.

Page 72. 2d. "The majority scheme has too many aspects and indications which are difficult to remember and understand and will be confusing to trainmen and enginemen."

As the minority does not present its so-called simplified scheme, no comparison can be made, and we are naturally at a disadvantage in argument. It is fair to state, however, that the 96 pictures will probably never appear on any one engine division, and certainly will only need to be read one at a time. In view of the fact that some roads now have, as stated by the vice-chairman in one of the earlier discussions, as high as 125 aspects, at the worst this scheme is simpler; as a matter of fact, the primary aspects consist of one, two or three-arm interlocking signals and an automatic block signal, and a switch target, all in use on the great majority of roads that have any signal installations of any size, a special mark to show permissive block, now shown by a distinctive position of the arm on many roads, slow track and resume speed signs of some kind are almost universally used, and a signal for block office closed is new and needed. If you have no occasion for signals, you would not need any of these aspects.

The minority says, page 73: "The engineer of a high-speed train should never be in doubt as to the meaning of a signal if he is to run safely; the signal should mean something perfectly definite to him, which he cannot mistake." We endorse this sentiment, and yet the simplified scheme presented by the minority for approval of this committee used the 45-degree position of the upper arm when there was a train in the block, perhaps within 300 or 400 ft. of it, when the next signal was at stop; when the next signal was at proceed with a route set up which could be run safely at 40 miles per hour; or for diverge right at the signal, safe speed 40 miles per hour. What a wealth of definite information, all embodied in one aspect! It's like saying that all the letters of the English language are included in the alphabet, and if you say "alphabet" to a man you've taught him the language. If you say caution to a man when caution is not needed, you mislead that man and you set a trap for him. All of you who have had anything to do with signals know that in the days when discipline was lax, a distant signal would be left at caution by a lazy operator, sometimes for all except two or three trains daily, and that engineman so finding it used to disregard it, and when interviewed would say: "It's always that way, it doesn't mean anything." The proposed scheme does give just that information which is needed and required by practical men on roads which have reached a considerable development. The simplifying of a system by the process of omission is a poor policy.

Precision vs. Brevity is a fair summing up of the situation, but the minority advocates precision by employing brevity.

The reference to train orders is very apropos, the train orders should be very brief, they must be exact. The application to signaling is obvious and need not be enlarged upon.

Page 73. 3d. No additional indications are necessary. We take flat issue with the minority members. The wording is that of the American Railway Association, to quote:

"Distant Signals—Name as used in rules, Caution Signal; indication for enginemen and trainmen, proceed with caution to the home signal; occasion for use:—home signal at stop, route is not clear.

Name as used in rules, Clear Signal; indication for enginemen and trainmen—proceed. Occasion for use:—home signal at Proceed route is clear."

Certainly the A. R. A. is more likely to favor its own phraseology than a departure from it, made on such hair-splitting lines, and we eliminated the words quoted by the minority on page 74 for the reason that we desired to follow the A. R. A. wording as far as possible. An arm at 90 degrees giving the indication "Proceed" involves no restrictions by signal indication and is the converse of Stop. Is there any reason why the same unrestrictive indication "Proceed" should not remove other restrictions that might be indicated by other positions of the arm or arms; any reason why it should not be the converse of other restrictive indications than stop—of all restrictive indications that might be given by the particular signal?

Page 74. 4th. In the preceding paragraph we were criticised in following the Code; in this paragraph because it is said we vary from the Code.

We have discussed aspect No. 8 for the past two years, in committee, before the Signal association, and here, and further discussion is unnecessary except to present the remedy advocated by the minority in committee.

The committee feel that if tracks are so arranged with long crossovers that a train may safely pass the home signal at 40 or 50 miles per hour, but cannot pass it at 70 or 80 without a bad lurch, the engineer should be warned of the safe speed, but should be allowed to take advantage of his track layout and not be required to reduce speed at the distant, prepared to stop at the home. That is, provided signals are installed to expedite movement and not simply to restrict it as much as possible. The aspect No. 8 they claim is not logical and their suggestion for correcting it is a very simple one. Eliminate the indication entirely—don't tell him he can go when all is right, but tell him to reduce speed prepared to stop at the home signal, because, forsooth, the occasion for use is pass home signal at 40 or 50 miles per hour. This process amplified and logically applied to a home signal, would reduce that to a one-arm signal only 0 then stop all trains that have to diverge at low speed, and flag by them.

Page 74, 5th—The committee stands on the principle that in a completed, uniform scheme, there should be two lights on each signal governing train movement, first, as a marker to distinguish between automatic and interlocking or telegraph block, (the action of this association having already asserted that a distinction of some kind is necessary) and second, as a marker, to show the location of the signal if the other light is extinguished at night. If this marker should not be red and display a stop signal when the other light is out, following strictly the rule that a signal improperly displayed is to be regarded as a stop signal, what color should it be? Obviously not green—proceed; obviously not yellow—caution; from our point of view obviously red, and red only. From the minority standpoint of brevity and simplicity, logically eliminate it entirely; but to do this no signal should have more than one light, consequently no diverging low speed routes could be signaled by fixed signals logically.

The Standard Code is admittedly a skeleton and not complete—one of its framers told me less than a year ago that it ought to be amplified and completed. Obviously in a complete scheme we give more indications than in an incomplete one—for confirmation of this statement see any good dictionary. Aspect No. 8 is absolutely consistent, in that it indicates unmistakably the position of the high and medium speed arms at the home signal, and that is what the fast runner wants to know.

Page 74, 6th—The same aspects are used for different indications and different indications for the same aspects. This sounds as if there were two objections, but both clauses mean the same thing. These variations are incident to the necessity already shown for information in the other positions of the arm—"the same aspects for different indications," is not an objectionable feature. If, however, these aspects might be misread so as to convey to the engineman a more favorable indication than he should receive, then they would be objectionable. This, however, is not the case.

Page 74, 7th—I will read the first three paragraphs on page 51. If the members have done as the committee requested, they can determine (with this statement of the minority as a guide) whether their operating officials are practical or impractical railroad men and those of you who are operating in an impractical way and who have anything to do with signaling, will perhaps recollect requests from such superintendents for more information rather than less.

The minority claims that the distant signal cannot be relied upon and that it should not indicate next signal at proceed, but should, in the clear position, indicate proceed to the next signal. How? Obviously in the only safe way, if it cannot be relied on, that is prepared to stop. Why then display the caution aspect, which means the same thing? More elimination, more brevity, more uncertainty, more delay, and less safety.

On this basis truly the American Railway Association is composed of members carrying on impractical operation, for the Code says: Distant signal, indication proceed—occasion for use—home signal at proceed. If the minority is correct in its treatment of the distant signal, where does the A. R. A. stand? The majority believes it is on firm ground.

How many of you are ready to do away with distant signals where high speed is required, and how many are ready to say to their engineers: "A home signal at stop means stop." A distant signal at caution means "prepare to stop any point beyond this signal." And the distant signal at clear "you have a clear track to the home and our apparatus is arranged to comply with A. R. A. requisites, so that in case of failure it will indicate caution, but nevertheless you mustn't place any dependence upon it, because it is unreliable?" In the 3-position automatic system the distant and home are combined in one arm. Are you prepared to say: "When the automatic is clear, reduce speed at once, the block is clear, but we don't rely on the indication?" Interlocking has been known to fail. Must a man prepare to stop at each clear home signal and feel his way? We endorse present practice. Do you say it is all wrong, dan-

gerous, subversive of discipline, and that it, by its encouragement of lax discipline, will lead to the use of cab signals, automatic stops, etc.? You have the word of the minority, three of the four men being operating men of note, that discipline cannot be maintained if this use of the distant signal is allowed.

The issue is clean cut. It means that you cannot discipline a man for passing a home signal and that your men will become careless and disregard the home signals, unless you require them to reduce speed so that they may stop at any point within vision beyond the distant signal and this on a crooked road. And this is the deliberate, considered opinion of the three operating experts of the minority. The committee states that most roads today use the distant signal is precisely the way condemned by these experts and asks you if discipline is lax; whether your men under this practice disregard your home signals and whether you will, by your votes, endorse the position of the minority, or will back up your committee, in the light of your experience, bearing in mind the fact, gentlemen, that signals do not enforce discipline; that duty devolves upon the officials in charge of transportaion. Page 76—In conclusion—In recommending a portion of the report for adoption the committee considered that this portion, covering the primary indications and aspects, had been worked out to a conclusion through several years of study and discussion during which no radical changes had been made. In the case of the secondary indications and aspects, embodied in the progress report, various schemes have been under discussion and the one presented was developed and agreed to within the past year. It therefore seems advisable to allow more time for consideration and possible revision before final action is recommended.

The only question affecting the wisdom of adopting a portion of the report, as recommended, seems to be, whether revision of the secondary system might make changes in the primary system necessary. On this point the committee feels no fear whatever. The report shows that a practical secondary system, in harmony with the recommended primary system, can be devised and the primary system is so we estabished that, beyond question, any desirable changes in the secondary system can and will be so made as to require no revision of the primary system.

The two following paragraphs the committee accepts as axiomatic. Read them. The system recommended will certainly help to bring about the condition stated in the first and involves no added mechanical or electrical complications that could result in an increased number of failures and false indications as compared with good signaling of the present day.

The minority says "any system which says any signal indications that a clear block signal means that the "Block is clear" of necessity encourage laxity." The A. R. A. Code says: Clear Signal—Proceed. Occasion for use:—Block is clear. Which is right? What use are block signals under the interpretation of the minority?

Evolution, not revolution is the object of this committee and we believe this association. Where is the minority position short of revolution?

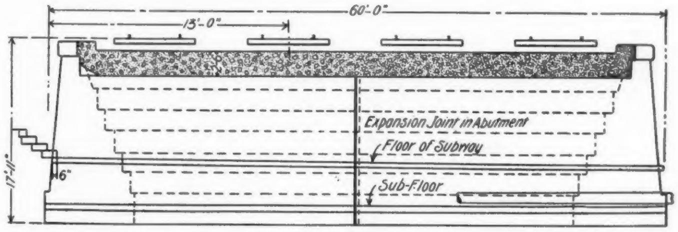
In the 2nd paragraphs on page 77, the minority defines what a consistent uniform system should cover. The committee agrees with this basis and submits its system as designed in conformity with it.

GRADE SEPARATION IN JOLIET, ILL.

The City of Joliet, Ill., with a population of about 35,000, is located 40 miles southwest of Chicago, and is connected with that city by three double track trunk lines, the Chicago, Rock Island & Pacific, the Atchinson, Topeka & Santa Fe, and the Chicago & Alton. A single-track line of the Michigan Central terminating at Joliet, connects with the main line of that road at East Gary, Ind., and the Elgin, Joliet & Eastern forms a double-track connection for frieght transfer with every road entering the Chicago territory. The Santa Fe and the Alton handle only through traffic; the Rock Island has both through and suburban service; the Michigan Central does a local passenger and freight business; and the Elgin, Joliet & Eastern handles only freight, of which a large amount originates in the Joliet manufacturing district.

All the roads entering the city except the Elgin, Joliet & Eastern, cut through the business district and cross the busiest streets. The Rock Island and Michigan Central are roughly parallel and approximately 700 ft. apart, running east and west. The Michigan Central's line ends in the eastern part of the city where its passenger station, freight depot and yards are located, but has two connecting tracks running west to a connection with the Santa Fe and the Alton. The Rock Island alinement has a I deg. 50 min. curve to the south near the center of the city, which ends in a 2,500 ft. tanget running southwest. This location is objectionable to the adjacent property owners on account of the odd shapes and sizes of lots that are formed, and to the public because the right-of-way cuts the corner of the square on which the court house is located, the tracks running between the court house building and a G. A. R. monument. The Santa Fe and the Alton are parallel and adjacent for the greater part of the distance through the city. They run north and south, crossing the Rock Island at grade near the business center of the city.

On account of the amount of street traffic in the section cut by the railways, it was desirable to separate the grades at all crossings in the business district. A general ordinance covering this work was passed by the City Council in January, 1906. The preparation of plans required some time and no work was done until the summer of 1907. Then the business depression made progress slow, and although the ordinance specifies December, 1908, as the date

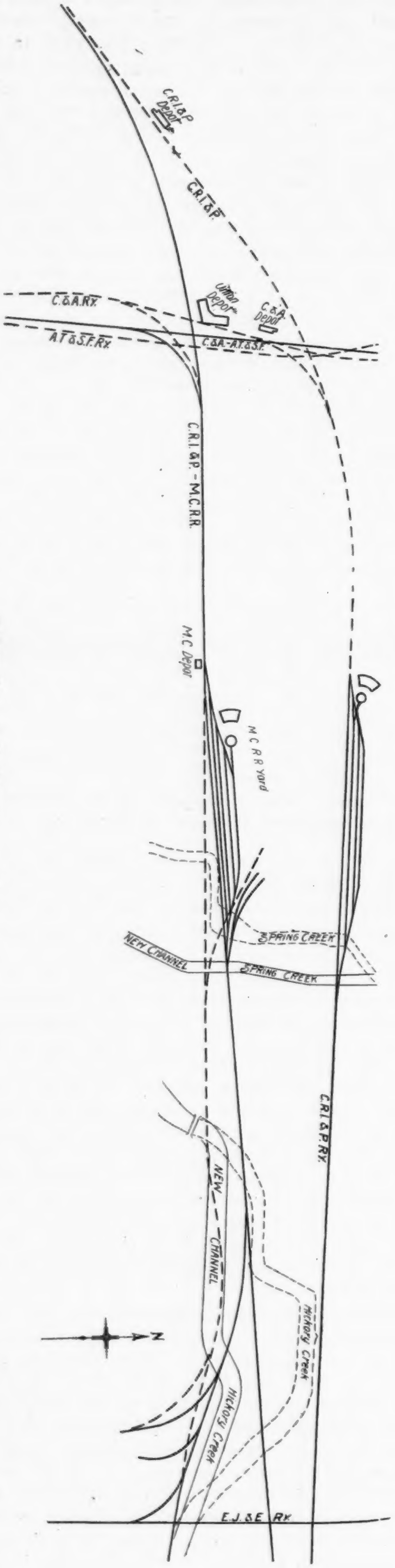


Longitudinal Section of Foot Passageway Under Rock Island and Michigan Central Tracks at Joliet, Ill.

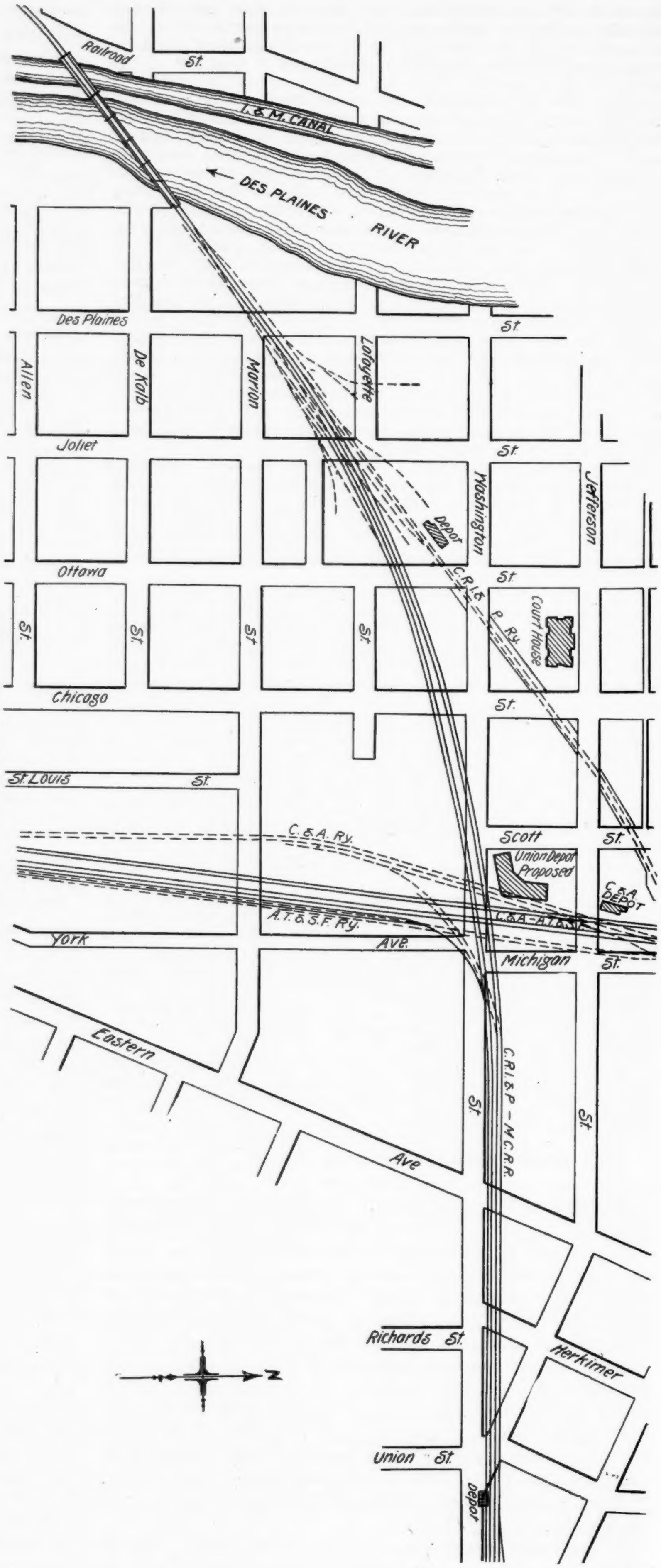
for the completion of the work it will probably be late in 1910 before it is finished.

The Rock Island under the terms of the ordinance abandons its right-of-way through a part of the territory affected, and the Michigan Central agreed to change the location of its line slightly, so that after the work is finished, the two roads will use the same elevated line. This permits the elevation of tracks and building of subways to be done jointly by the two companies. An important argument in favor of this plan was the desire of the county authorities and the public to have the tracks removed from the Court House square. The new union passenger station which is now being planned is also a result of this re-location, since it furnishes a common intersection point of the four roads at which to locate the building. The plan as adopted necessitated the abandoning of considerable property and the buying of more by the Rock Island and Michigan Central, but this expense was offset by the economy of building one embankment instead of two and of conducting the entire work with one field organization.

The Rock Island re-location is approximately two miles long, the maximum distance between the old and new line being about 800 ft. The new line to be used by both Michigan Central and Rock Island, is about 150 ft. from the present line of the Michigan Central at the point where the two re-located lines meet and from this junction west, the joint line and the present Michigan Central line slowly converge, meeting near the present passenger station of the latter company. A special problem in this relocation work was the changing of the channel of a shallow winding stream, known as Hickory Creek, whose natural course crosses the new line of the Rock Island east of the junction



Relocation of Railways in Joliet, Ill.
New lines shown solid.



Section of Track Elevated at Joliet.

with the Michigan Central, runs west along the joint line about 1,500 ft. and crosses it again. To eliminate one crossing a 100 ft. channel was dug which will carry the stream under the Michigan Central tracks east of the junction of the two roads, and then west parallel with the tracks to the inter-section with the old channel. With the exception of the sharp bend necessary to cross the Michigan Central, the new channel will be straight, so that in flood seasons, the water will be removed more rapidly than at present. The two tracks of the Michigan Central are carried over the new channel on a girder bridge similar to the subway bridges mentioned below. Two piers are placed in the channel, the total width being increased to allow the same clear waterway as in the standard channel section.

Another small stream called Spring Creek, which crosses the joint line a little farther west, has recently been straightened and deepened by the two companies working in conjunction with the Spring Creek Drainage District, and this new channel was bridged by reinforced concrete floor slabs carried on longitudinal steel girders. of 60 ft. span. The structure carries six tracks, spaced 13 ft. center to center. The floor slab is built in sections 13 ft. wide separate by mortar joints, each section resting on two girders on 7 ft. centers placed symetrically about the center line of the slab. The slab reinforcing is of deformed bars, spaced on 4 in. centers, every third bar of the lower plane reinforcing being bent up to carry the shearing stress. Drainage is provided by crowning the slabs 2½ in. and embedding 2 in. gas pipes vertically in the concrete at 10 ft. intervals along the joints.

The section of track to be elevated is approximately one mile long, extending from Railroad street, just west of the Desplaines river, to Collins street, on the east side. There are eight subways and one foot passageway to be built in this distance.

With the exception of Chicago and Scott streets, all the subways are of the girder type with I beams carrying a water tight floor pan 10 ft. in width, which retains the ballast, the open spaces between the outer edges of floor pan and girders being filled with concrete to give a water tight construction over the entire bridge. Twelve feet of clear headroom for the street traffic is required except at Chicago street and Eastern avenue, where 13½ ft. headroom is required to accommodate street railways. The abutments are of mass concrete, the proportions being 1:3:5 except in the bridge seats and back walls, where a 1:2:4 mixture is used. Plans for the Chicago and Scott street subways are not yet decided on, but will probably be of the concrete encased I-beam type.

It will be necessary to raise the bridge over the Desplaines river one or two feet in order to get the grade high enough at Railroad street, to enable a subway to be built with the required clearance and with a free drainage into the river. The raising of the bridge will not be difficult, as the abutments and piers are of concrete and of limestone quarried in the locality, and while the bridge is jacked up under traffic, a course of stone or concrete of the desired thickness can be laid.

At Collins street the City permitted the closing of the street to vehicular traffic, but insisted on having a foot passageway under the tracks. This was made by spanning a 15 ft. opening with a reinforced concrete slab. The slab is 2 ft. 6 in. thick, 54 ft. 4 in. long, and carries 4 tracks. The lower plane reinforcing consists of ⅞-in. square bars set longitudinally on 3 in. centers and ½-in. square bars set transversely on 2 ft. centers. In the upper plane ½ in. square bars are spaced on 2ft. centers in both directions. The web stresses are provided for by bending up three of every four of the ⅞-in. bars and by the addition of ½ in. square bar stirrups. The slab is crowned 3 in. longitudinally and carries a minimum depth of ballast of 8 in. The drainage carried over the rear wall of the abutments enters a layer of coarse filling which conducts it to a 4 in. vitrified sewer pipe extending the full length of the abutment and draining into the gutter outside of the retaining walls. The slab top and rear walls of the abutments are waterproofed by a coating of asphalt paint.

The retaining walls are of mass concrete, of standard gravity section. The dimensions vary with the location, the width of base being kept at least one-half the height. The inner surface is battered 1 to 3 for a distance of about 5 ft. from the top and from there down it is stepped off with bearing surfaces 10 in. wide, and rises 2 ft high. The outer face has a batter of 1 to 12 with a 1 ft. 6 in. coping at the top. Good footings for all masonry work were obtained at a maximum depth of 5 to 7 ft. below the surface. Bed rock is very near the surface in some places and in others a footing on boulders and coarse gravel was used. The footings were made of concrete in rough forms with reinforcing bars extending about 18 in. above the surface to form a bond with the wall. Drainage is provided by embedding 4 in. drain tile in the wall just above the ground level at 20 ft. intervals. The concrete proportions in the retaining walls are the same as mentioned above for the subway abutments, 1:3:5 for the body of the wall and 1:2:4 for the coping. The mixing was done in a 22 cu. ft. capacity Smith and Koehring mixer and the materials before and after mixing were handled in Koppel cars.

The problem of filling to required grade was a comparatively simple one. The necessity for caring for traffic during the work was eliminated as the new line does not seriously interfere with the existing operating tracks. The material for filling was obtained from the cut made for the new channels of Hickory Creek mentioned above and consisted of fine gravel, coarse gravel and boulders in various proportions. It was very hard to handle on account of a natural cement filling which made portions of it as compact as solid rock. Parts of the deposit could be handled with a steam shovel, but most of it had to be blasted down from the vertical working face. The filling was done from cars by unloaders and spreaders.

The work on the Santa Fe and the Alton is divided into two sections, and by an agreement between the two companies, the Santa Fe prosecutes all work north of the crossing with the Rock Island Michigan Central line and the Alton all south of that point. Work by both these forces has progressed somewhat more slowly than the Rock Island Michigan Central work, and although most of the filling is done, none of the permanent subways are yet in place. The two companies adopted very different methods of accomplishing the filling work. The Santa Fe built a double-track pile trestle and filled from that while the Alton raised the tracks as the filling progressed by tamping in filling sand.

The joint work of the Rock Island and Michigan Central is being done under the general supervision of J. B. Berry, chief engineer of the Chicago, Rock Island & Pacific, and G. H. Webb, chief engineer of the Michigan Central. The field work is in charge of G. H. Harris, assistant engineer, Michigan Central Railroad. The Santa Fe work is being done under the general supervision of W. B. Storey, Jr., vice-president of the Atchison, Topeka & Santa Fe and the Alton work under the direction of W. D. Taylor, chief engineer of the Chicago & Alton.

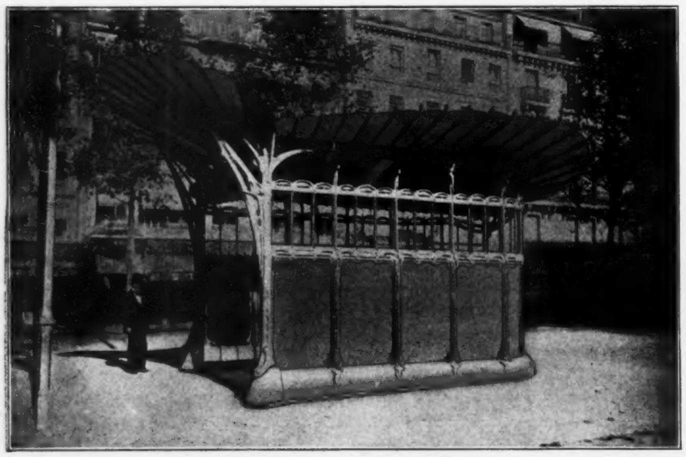
R. Emerson, formerly assistant to the general manager of the Lehigh valley, who has recently returned to the motive department of the Atchinson, Topeka & Santa Fe, with which he was connected before going to the Lehigh Valley, was a visitor at the convention and the exhibition at the Coliseum Tuesday.

SHELTERS FOR SUBWAY STAIRS.

The Boston Transit Commission, in passing on work in Boston, has discussed and illustrated various types of stairway shelters for subways.* The accompanying photographs show subway stairs in Boston and in other cities. Where the subway stairs in Boston were somewhat distant from

Paris Subway; Open Stairway.

other buildings, so that they did not obstruct the sight to and from them, the design of the shelter was such as to combine architectural beauty with adaptability to the particular needs of that subway station. This was the case with the stairway shelter at Scollay Square and at Boston Common. At Haymarket Square the shelter was designed solely for the purpose of forming a shelter over the stair-

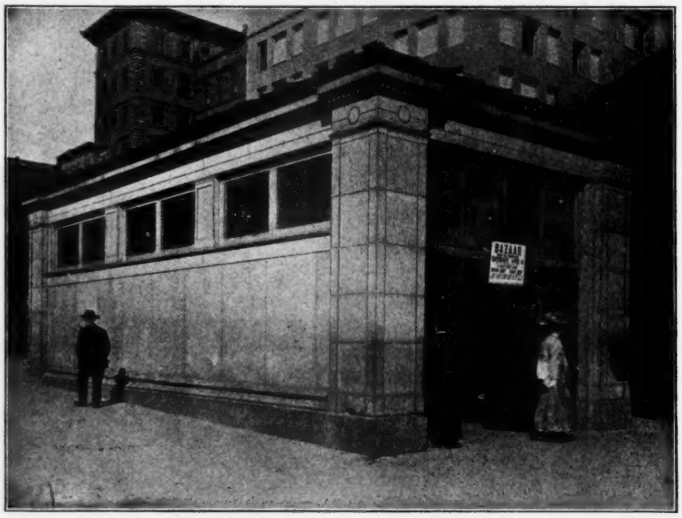


Paris Subway Station, Parte-Maillot.

way and adjoining sidewalk, and no attempt was made to give the structure architectural beauty.

The subway stairs at Old South Church and at Adams Square were near other buildings, and various plans were considered for making the shelters as serviceable as possible, and at the same time making them of such a shape as to give the minimum interference with sight from the buildings. The commission considered making open stairways, such as are shown in the pictures of the Metropolitan subways of Paris and the Berlin subway. It was decided, however, that this would not be satisfactory, and that something more even was needed than the half covering of the stairway, as shown in the picture of the New York subway entrance at Fulton street. The photograph of the stairway to the Washington street tunnel at Old South Church shows the design finally adopted by the commission.

This concrete stairway shelter was cast as a monolith, except for the window fixtures on the side, which were molded separately and bolted in the forms before the concrete for the rest of the shelter was poured. Wood forms



Boston Common Subway Entrance.

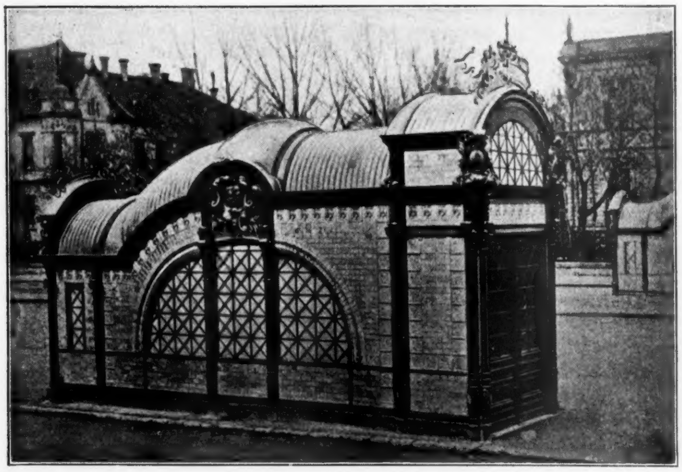
were used, which were erected complete except for the lagging on top of the roof before any concrete was placed. The concrete or mortar was poured in a practically liquid condition and required very little ramming. The same set of forms were used with slight alterations for three shelters. Sheet glass was not used, because the commission thought that in most places where this type of structure had been used the glass had very quickly cracked. The

Haymarket Square, Boston.

photograph of the covering for the Paris subway at Porte Maillot shows, however, an exception to this rule. Pane glass was used for this shelter, but has not cracked.

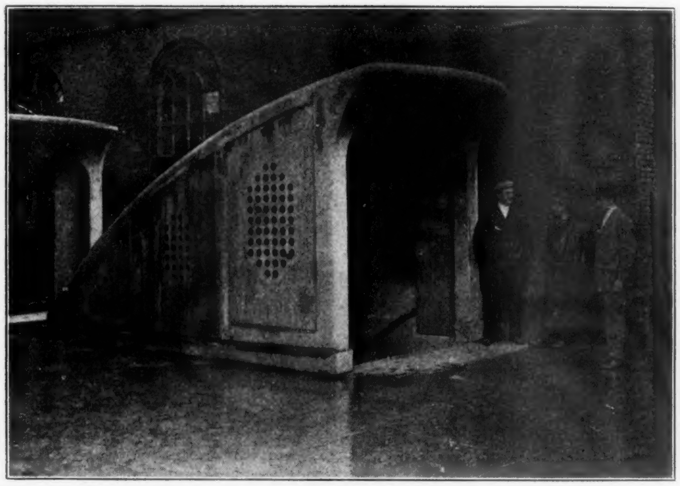
In answering criticisms of the design of shelter used at Old South Church, the Boston commission quotes from an article on "Expression in a New Material," in the *Architectural Record*, New York, April, 1908. The article in dis-

*Report for the year ended June 30, 1908.



Budapest Subway Entrance.

New York Subway Stairs on Broadway.



Boston Subway at Old South Church.

Berlin Subway Stairs.

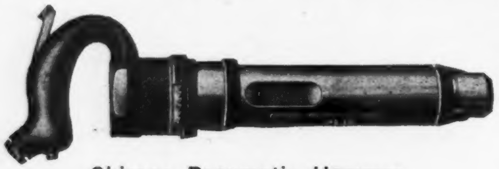
New York Subway; Fulton Street.

Boston Subway; Scollay Square Station.

cussing the design of concrete structures says: "The conventional form handed down to us in the motives of articulated stone and timber architecture should be abandoned, root and branch, because entirely without relation to monolithic construction; . . . ."

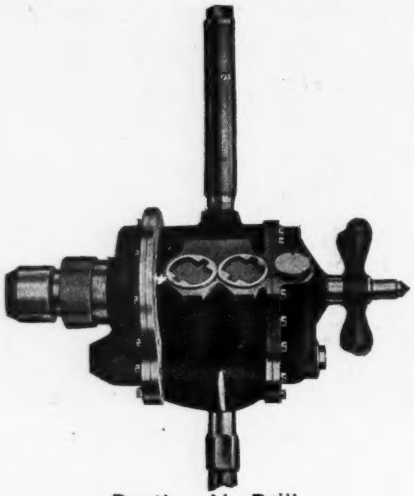
CHICAGO PNEUMATIC TOOLS.

The range of adaptibility covered by the line of drills, made by the Chicago Pneumatic Tool Co., Chicago, seems not to have reached its limit and progress continues in the development of this tool for uses outside of the regular drilling operations. One of the recent applications is the combination of the Duntley 550-volt drill with the Boyer angle gear in a track drill to accomplish quick and accurate work in track drilling.



Chicago Pneumatic Hammer.

Looking forward to the extended use of screw spikes, the universal adoption of which seems inevitable for the preservation of wooden ties, the Duntley electric spike driver provides the railways with the valuable tool for the application for screw spikes.



Duntley Air Drill.

Several designs of pneumatic hammers placed on the market by this company for riveting, calking and chipping continue to hold their prestige and the company reports a gratifying increase in its output and in the number of users, both in this country and abroad.

SELLERS ANCHOR BOTTOM TIE PLATES.

The Sellers Manufacturing Company, Chicago, has on exhibit in Space 123 several different sizes of its Sellers anchor bottom tie plate. This plate has a corrugated bottom which takes a firm grip on the tie and holds the track to gage under very severe conditions and without tearing or injuring the tie. This plate is now said to be in use on more than 100 of the leading railways of the country.

The Road & Track Association has arranged to run limousine cars between the Congress hotel and the Coliseum on a five-minute schedule for the convenience of those who wish to visit the exhibition. To distinguish these cars from others, a banner bearing the name of the association, was attached to the car, but as all kinds of advertisements are prohibited on Michigan Boulevard, the banners were taken off and an American flag has been substituted, that the cars may be readily distinguished.

REGISTRATION.

These names belong on the Registration List in addition to those printed in another column:

Backes, W. J., Chief Eng., Cent. New Eng. Ry., Hartford, Conn.
Bagg, F. A., Eng. F. J. & G. R. R., Gloversville, N. Y.
Beagles, Fred, Asst. Eng., O. R. R. & N. Co., Portland, Ore.
Begien, R. N., Division Engineer, B. & O. R. R., Philadelphia.
Bergen, W. J., Asst. to C. E., N. Y. C. & St. L. Ry., Cleveland.
Beye, John C., Loc. Eng., C., R. I. & P. Ry., Chicago, Ill.
Chadbourn, W. H., Prin. Asst. Eng., C. G. W. Ry., Chicago, Ill.
Clausen, L. R., Supt., C., M. & St. P. Ry., Chicago, Ill.
Coburn, Maurice, Prin. Asst. Eng., Vandalia Line, St. Louis, Mo.
Cowper, J. W., Worden-Allen Company, Chicago, Ill.
Cutler, A. S., Asst. Prof. Ry. Eng., Univ. of Minn., Minneapolis.
Delo, C. G., Engineer M. W., Nat'l Rys. of Mexico, Mexico.
Denney, C. E., Signal Eng., L. S. & M. S. Ry., Cleveland, O.
Emerson, R., A. T. & S. F. Ry., Chicago.
Fulks, E. B., American Creosoting Co., Chicago, Ill.
Howard, R. H., E. M. W., C. & E. I. R. R., Chicago, Ill.
Jackson, E. D., Asst. Eng., B. & O. R. R., Baltimore, Md.
Khuen, Richard, Resident Engineer Am. Bridge Co., Pittsburg, Pa.
Kimball, G. H., Consulting Engineer, Detroit, Mich.
Kuehn, A. L., Genl. Supt., American Creosoting Co., Chicago.
Lee, E. H., Chief Engineer, C. & W. I. R. R., Chicago, Ill.
Long, M. A., Architect, B. & O. R. R., Baltimore, Md.
McNeill, J. E., A. T. & S. F. Ry., Los Angeles, Cal.
Merrell, G. W., Asst. to G. M., N. & W. Ry., Roanoke, Va.
Parker, Chas. J., Prin. Asst. Eng., N. Y. C. & H. R., New York.
Puder, F. R., Asst. Eng., Chicago Sou. Ry., Chicago, Ill.
Reichmann, A. F., Resident Engineer, Am. Bridge Co., Chicago, Ill.
Ritter, Louis E., Consulting Engineer, Chicago.
Safford, H. R., Chief Engineer M. W., I. C. R. R., Chicago.
Schneider, C. C., Consulting Engineer, Phildelphia, Pa.
Schwitzer, J. E., Asst. Ch. Eng., C. P. R., Winnipeg, Can.
Scott, Guy, Eng. M. of W. Pa. Lines, Toledo, O.
Shurtleff, A. K., Office Eng., C., R. I. & P. Ry., Chicago.
Simmons, I. L., Bridge Engineer, C. R. I. & P. Ry., Chicago, Ill.
Slifer, H. J., Gen. Man., C. G. W. R. R., Chicago, Ill.
Stewart, A. F., Asst. Chf. Eng., Mackenzie, Mann & Co., Toronto.
Walker, G. M., Jr., Asst. Eng., K. C. T. Ry., Kansas City, Mo.
Webb, Walter Loring, Con. Eng., Philadelphia, Pa.
Weston, C. V., President, South Side Elev. R. R., Chicago.
Wishart, J. A., Ch. Draftsman, C., R. I. & P. Ry., Chicago.
Woolley, B. C., Civil Eng., Sioux City, Iowa.

ROAD AND TRACK SUPPLY ASSOCIATION.

The annual meeting of the Road & Track Supply Association was held at the Coliseum, Tuesday afternoon, March 15th, for the purpose of electing officers for the ensuing year and also for the transaction of other business. The following were elected: T. W. Snow, president, Otto Gas Engine Works, Chicago; R. E. Belknap, vice-president, Pennsylvania Steel Co. and Maryland Steel Co., Chicago; John N. Reynolds, secretary and treasurer, western manager, Railway Age Gazette, Chicago. Executive committee: John McKinnon, Kalamazoo Railway Supply Co., Kalamazoo, Mich.; George Stanton, Cleveland Frog & Crossing Co., Cleveland, Ohio, A. P. Van Schaick, W. K. Kenly Co., Chicago; Azel Ames, Kerite Insulated Wire & Cable Co., New York; T. W. Wyles, Detroit Graphite Co., Detroit, Mich.; and George Isbester, Q. & C. Co., Chicago. A. F. Schleiter, Dilworth, Porter & Co., Ltd., Pittsburg, Pa., the retiring president, was elected ex-officio member of the executive committee for one year.

At the meeting it was decided to change the name of the

association to the Railway Appliances Association, it being considered that this name is better adapted to the purposes of the association.

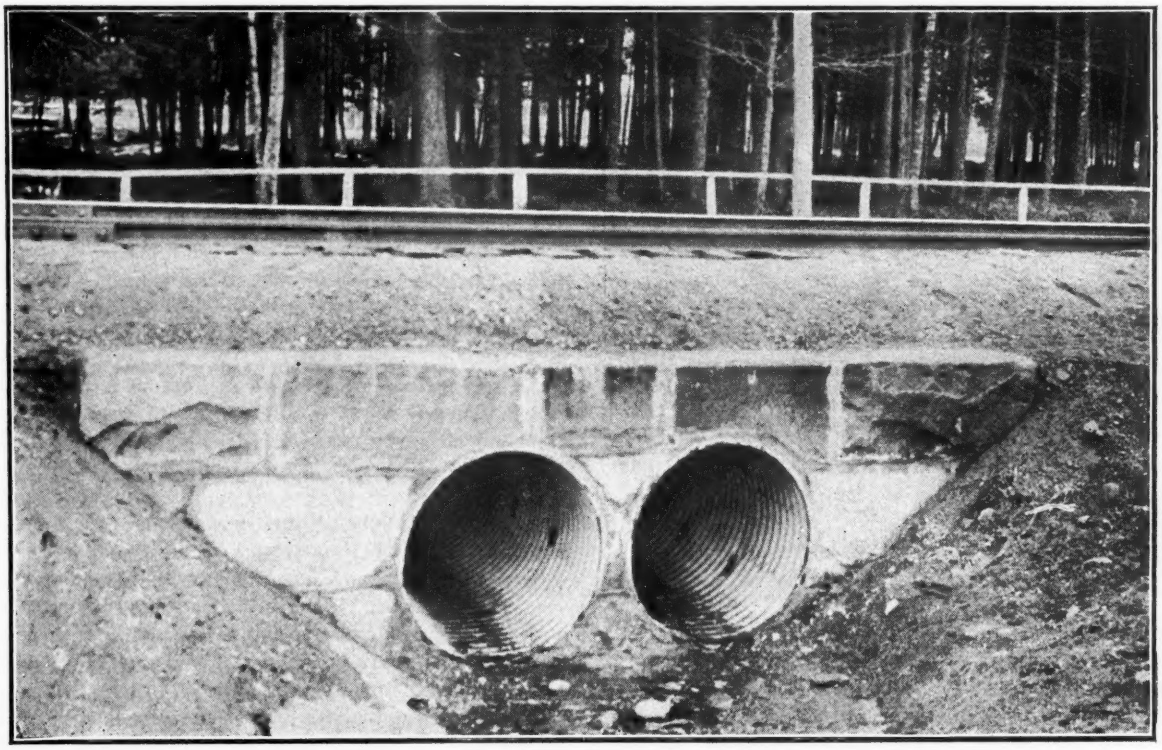
CORRUGATED CULVERT PIPE.

Among the exhibits at the Coliseum there is one of an iron culvert pipe laid beneath a track whose ballast and bed is of a finely broken stone. The ends of the pipe are embedded in concrete walls and project slightly from the surface of the same.

It is safe to say that, a few years back, such an exhibit would have received but scant consideration from practical men, who would have seen in it all of the elements of an early and rapid deterioration from corrosion, together with the attendant inconveniences of a correspondingly early replacement. Sentiment, at that time, was divided between the desirability of using cast-iron and vitrified pipe. The latter possessed the advantage of an indefinite life, barring breakage, but did not have the strength to carry heavy concentrated loads and did its best work when well below the track. The cast-iron pipe was slow to rust and had the strength needed for use in any position, but would decay and did have a limited life. It was, however, heavy and could not be easily handled. The question was to provide a material that had the strength of the cast-iron, some approach to the life of the vitrified pipe and should posses an added advantage that neither of the others had—lightness.

In all the navies and merchant marine of the world the corrugated furnace is in use. It is in the form of a corrugated cylinder, whose corrugations are uniform in depth and pitch and whose strength is varied by the thickness of the metal. It is possible, with the diameters in use, of four ft. and over, to sustain steam pressures of from 200 to 225 lbs. per square inch. such a pressure (200 lbs.) when applied to a furnace of 48 in. in diameter is equivalent to a uniform loading of 115,200 lbs. per lineal foot. This is merely cited to indicate the possibilities of the resistance of metal to external pressures when put into this shape.

It is this principle of which advantage has been taken in the designing of the corrigated culvert pipe in the exhibit to which allusion was made. In this work, of course, no such loads as that required for boiler purposes, will have to he carried, so the corrigations are made more shallow and the metal used is much thinner. In general, too, the imposed load will be of a different character, though there are indications that certain materials, especially some of the clays act exactly like liquids in the distribution and augumentation of their pressures. Hence it might occur that a load placed upon the top of a bank might be carried directly down to the culvert pipe beneath. If such a case were to be supposed, and a load of 30,000 lbs. were to be taken down vertically from a half tie length, it might happen that the culvert would be called upon to carry, say 9,000 lbs. per lineal foot. Tests have been made where the imposition was 22,300 lbs. per lineal foot with no injury to the metal, or more than two and a half times that of the heaviest locomotive, thus showing that the principle so successfully applied to steam boilers holds, as it ought, to the use of culvert pipes. It is evident, then, that strength has been cared for.



Corrugated Culvert Pipe Used With Concrete Walls.

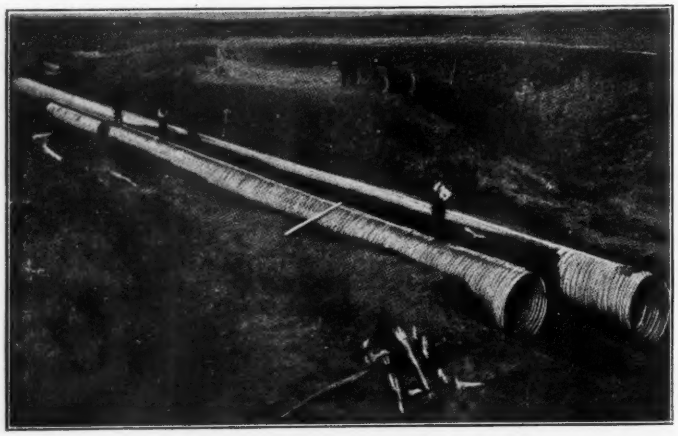
But of a far different character is the question of durability, and it does look risky to put a sheet of metal of from 12 to 16 gauge in thickness, in a bank subject to the direct action, not only of the water flowing through it, but to the leakings from above.

About eighteen years ago, it was suggested that the corrosion of iron and steel, was due to an electrolytic action caused by a current set up by the contained impurities, and it was urged that if a perfectly pure and homogeneous iron could be obtained, the rapidity of corrosion under ordinary conditions would be greatly decreased, and above all that what did occur would be distributed evenly over the surface and would not be marked by that pitting which is so characteristic of the corrosion of ordinary samples of iron

and steel. This theory is, now, very generally accepted as correct.

Quoting from a recent work on the subject: "all non-homogeneous metals and therefore all commercial iron and steels are doomed to decay unless adequately protected. In the case of the metallic impurities there which, like manganese, are themselves more liable to corrosion than iron, will act unfavorably." It was discovered, two years ago that "segregated manganese formed centers of corrosion." As for carbon, inasmuch as it allows hardening, it will act as a protection, "provided it is combined with the iron and uniformily distributed," but, "when present in the free state will, by contact action promote corrosion."

The problem, then, was to produce an iron that should be pure and being pure must be homogeneous. This found, the use of it for culvert pipes could be considered safe. The ingot iron that is rolled, corrigated and manufactured into culvert pipe, is claimed to be 99.94 per cent. pure.



Culvert Under Railroad Yards.

That is it is ferrite. The impurities are sulphur, phosphorus and carbon.

One sample tested showed.

Sulphur	.021	per cent.
Phosphorus	.005	„ „
Carbon	.02	„ „

Of these, phosphorus appears to retard corrosion.

It is not claimed, therefore, that the metal is absolutely non-corrodable, but that it is so pure and so homogeneous in its structure, that whatever corrosion does take place will be evenly distributed over its whole surface and will advance so slowly, that even the thin sheets used, are essentially indestructible.

The three points attained, then, are lightness, strength and durability, the three that go to make up the desirables of culvert construction.

As to its method of application, that depends upon local conditions solely, the character of the structure and the individuality of the engineer in charge. It may be embedded in a concrete wall at each end as shown at the exhibit, with the ground tamped about it dry or puddled. Or it may be used in an earth embankment, with no end protection, dependent solely upon the impermeability of the filling, to prevent leakage. Of course, it is not proof against leakage through the bank along its outer surface in the case of poor workmanship. But it has the strength to carry any depth of cover, or may be set so close to the rails as to sustain the direct thrust of the wheels.

In form it is a simple corrugated tube, made up of lengths of about 2 ft. rivetted together, and galvanized, though the galvanizing is done prior to the rivetting. One of the illustrations shows a culvert set less than its own diameter below the rails, and with a 50 ton engine above it. Another shows a twin culvert with concrete end walls, also close to the rails, while a third shows two long tubes set in place ready for the fill covering to be put on.

These are examples of the practical application of the idea, showing that it is one which appeals to engineers as a means of obtaining, at a low cost, a strong and light construction which gives promise of great length of life.

RAILWAYS AS CITIZENS.

By WILLIAM H. BOARDMAN, Editor of the Railway Age Gazette.

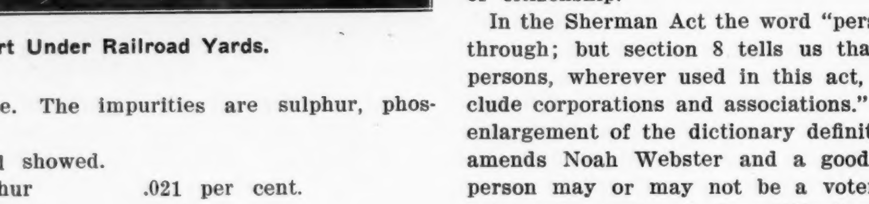
I know many railway officers who, at the time of the last election for President of the United States, felt somewhat like the log driver with three red-haired daughters. The oldest one had been long, overlong, in the matrimonial market, and she was detaining the others. He was anxious; his wife was anxious. When she telegraphed him that the oldest girl was engaged, he answered: "Thank God, the jam is broke." Looking backward, there are reasons for thinking that some of the logs in the jam are loosened, and that the railways have accomplished this by their own acts of citizenship.

In the Sherman Act the word "person' is used all the way through; but section 8 tells us that "the word person or persons, wherever used in this act, shall be deemed to include corporations and associations." This is a considerable enlargement of the dictionary definition. The Sherman Act amends Noah Webster and a good many other folks. A person may or may not be a voter. A corporation can't vote, and occasionally has difficulty in getting votes. Both are alike citizens. The railway company is domiciled in each community it serves, and has plain duties of citizenship enlarged in full proportion to the size of its interests in those communities.

In this attitude of corporate citizenship I hope we have passed through two phases, and that we are entering upon a third and last one. The last is to be somewhat like the first; but a great improvement on it; the middle one was outrageous.

The pioneer promoter of railway building was always a great man. He built roads in barren lands and coaxed people to come in and make them bloom. Bold and imaginative, his work lives after him, although he usually busted up.

Here is a sample of many cases: The promoter built a city on his line, largely of architect's plans and of material used for castles in the air. He established banks, water



Section of Corrugated Culvert Pipe.

and gas companies and Y. M. C. A. associations. At the inevitable meeting of his creditors, he made a tearful speech: "I surrender to you everything that I possess (the rest was in his wife's name). If it will better the situation, divide my body among you." An unfeeling creditor said: "Then put me down for his gall."

Note one fact seriously. The state did not make or regulate the early railways. The early railways made the state, and are now continuing to make the existence of the state possible.

* * *

There was a middle period or phase when the railways were hostile, domineering, mysterious. This has been changed by methods comparable to the American Revolution, or the Civil War—indiscriminate attacks, just and unjust, hostility to everything that bore the name of company or corporation. It has been brutal, but it has been effective. I sincerely believe that the railways, as a whole, are now more exactly law abiding and, as citizens, are more helpful than any other class of persons. They are more helpful when they do their full duty, simply because they are bigger citizens.

In the southerly corner of California there is a valley of nearly a million acres as fertile as any in the world. It is irrigated by a canal from the Colorado river, built by the California Development Company. The Colorado is a great flood river; it is powerful and mischievous. Four years ago it tore through the canal and, instead of quietly keeping on its way to the Gulf of Mexico, it began to make the Salton Sea, in the Imperial Valley of the state of California. The development company could not stop it without help, and the Southern Pacific Company loaned them about a million and a half dollars to do it. But the Colorado river seemed to be hell bent on abandoning its Mexican direction and fighting its way northerly. It broke through again and again in the light alluvial soil, each time at places nearer and nearer to the Mexican boundary. At these points the river is the Colorado-California state boundary, and the last break was close to the Mexican line. It was an interstate and was becoming an international incident when, at the end of 1906, a flood without precedent tore an opening one-fifth of a mile wide and 34 ft. deep, through which the Colorado went at 4½ miles an hour, to the doomed Imperial Valley.

The Southern Pacific has a branch, not a main, line in this valley. The company was simply one of its 10,000 citizens, with possibly less at stake than some of the others. The responsibility for stopping the break was probably on the United States Reclamation Service, but the company had the facilities for immediate action and did not hesitate a moment. It did not hesitate, although the demand of the President of the United States for action was irascible and unjust. All the cars and men for which there was room were put to work. The crevasse was closed in 15 days, and the closure was made permanent by half a mile of dam and 15 miles of levee. The cost of it all was $3,150,000, paid by the Southern Pacific Company and never refunded to it. It was greater than the whole cost of the company's branch line in the valley. The Southern Pacific proved its citizenship.

Mr. Harriman ("Is Saul among the prophets?") was in other ways a most enlightened believer in the citizenship responsibilities of his companies. They are carrying on in the great West a form of partnership with the business associations—state, county and city—by means of which enterprising men and educated young men the world over have correct information of the possibilities of the West, and these companies are peopling that great region with desirable citizens. The present day idea of a railway president is that he is a man of no principles and few prejudices, but we might say in Irish: "Half the lies told about him ain't true."

* * *

On August 3, 1898, just after the Spanish War, the Long Island Railroad was notified that a convalescent camp for the Fifth Army Corps would be established on the Dunes, near Montauk Light, on the east end of Long Island, and that the cavalry regiments would arrive with their horses in Long Island City within three days. It was indeed fortunate that this poor, light, single-track road had as president a great citizen, William F. Baldwin, who has since died in his prime.

He called his staff together and talked to them: We are facing a tragedy. 25,000 men and all that they need must be carried at once over 116 miles of single-track to a terminal where nobody lives and where there is now only a ticket office and a 1-car siding. We haven't the engines, the cars or the terminal yard at Montauk for handling them; it looks impossible, but we must do it. We must spend ourselves; and he quoted: "Whosoever would save his life shall lose it."

They borrowed engines and cars; they did not spare themselves, these citizens, and when, on the second day, the army came, they moved it promptly. In less than a week they had built at Montauk a four-mile distributing yard, unloading platforms for animals and wagons, cooking and sleeping houses for the railway employes, two large freight houses, a water supply and all the necessary equipment for a busy terminal.

The railway hauled in its own materials and all that was wanted for the new government storehouses, general hospital and detention camp. It moved 35,000 officers and men, 8,750 horses and mules, with their belongings, daily food and other needs. For a few weeks the little single-track road was the busiest line in the world; then the army folded its tents, like the Arab, and as silently stole away.

There are many less spectacular instances in the development of citizenship. Self-sacrifice and free gifts are not long remembered. Broad-minded selfishness is the most interesting phase of corporate management. When L. F. Loree became general manager of the Pennsylvania Lines West of Pittsburgh, he found the trains, the right-of-way and the yards infested by vagrants and tramps. They rode on the trucks and blind ends of postal and express cars. They got killed, had to be buried, and pretty often their lives or legs had to be paid for. They stole from the cars and stations and from the residents. They caused fires and had an insane bent for petty crimes. The vagrant laws varied widely through Indiana and Ohio, but this was unimportant while they were not enforced.

Loree employed Josiah Flynt, the literary hobo. He spent weeks on the line, disguised as a tramp, and made a fine report on the damage, the cause and the cure. It needed cooperation between the railway and the municipal authorities. Loree finally got splendid cooperation. Either personally or through members of his staff, he met and had it out with all the municipalities on his line. His general proposition was: We will arrest and bring in every tramp in the region, if you will enforce the law. They all accepted it. He formed an unusually sturdy police force, and for a few weeks they had the time of their lives. It was team work, and they made touch-downs less gently than the football teams, until suddenly in all that region the tramp became as extinct as the buffalo on the western plains.

There are now going on numberless railway undertakings to make their fellow citizens well to do. You may call this patriotism, or enlightened selfishness, but one of these terms may be a definition of the other one.

Mr. Delano, on his lines in Missouri, is showing the

man from Missouri; he is spending money and time in encouraging the study of agriculture along his lines.

Mr. Brown, of the New York Central, has citizenship in seven states and is buying quarter-section farms in each of them to be used by the state as experiment and demonstration farms. Being a farmer himself, he knows that the productiveness of land can be largely increased, and at a large profit.

Mr. Peters, of the Long Island road, has already nearly doubled the money value of Long Island garden truck by his two experiment gardens and his fortnightly bulletin of results.

By personal intercourse with his company's fellow citizens in the southern states, Mr. Finley has converted one of the worst possible situations to one of the best situations. He has been patient under the hostilities, long enduring with fanaticism, law abiding but firm and skilful in getting true interpretations of the law. "The law is good if a man use it lawfully." This is what St. Paul wrote to Timothy, but Finley has also read, out of the tail of his eye, another remark by St. Paul: "Law is not made for the righteous man, but for the lawless and unruly; for the ungodly and sinners." His ungodly neighbors now know he read that. He has been firm as well as kindly to his neighbors and is surely well on the way to making their region and his company highly prosperous.

Looking back over the period since the last general election, I think the railway officers were then right in believing that the jam is broken. We get a line on public opinion largely from the newspapers, partly from the action of the state commissions and negatively from the demagogues. The man who has observed but a few facts can make up his mind with great definiteness. A careless or ignorant paragraph in his newspaper may establish for life the commonplace man's opinion about railway corporations. Nevertheless, in the long run, public opinion is about right. From the storm of bitter hostilities the railways are coming to reasonably good weather. Under the leadership of great men they have substituted frankness with the public for mystery, a neighborly attitude instead of hostility and successful overtures for cooperation with the towns, cities, counties and states in which they are powerful citizens.

It is true that the railways are creatures of the state, but I will repeat once more, the railways have made the state. They will get justice for two reasons; because we are a just people, and because we cannot get the highest measure of prosperity unless they are so highly prosperous as to serve us well.

LIST OF EXHIBITS.

The following are printed to correct errors of omission or commission in yesterday's Daily:

American Rolling Mill Company, Middletown, Ohio.—American ingot iron corrugated culverts. Represented by G. H. Charls, Ray Frazer, Jos. DeFrees, F. M. Beach, A. B. Nilder, Howard O'Neal, C. C. Fouts, G. Ahlbrandt, J. A. Hupperle. Spaces 75-76.

Dorp-Mueller Company, New York.—Anti-creepers. Represented by A. Dinklage.

Fairbanks Company, New York City.—Dart union couplings. Dart flange couplings, Fairbanks valves, P. & C. blow-off cocks. Represented by L. B. Mann, G. W. Conine, F. M. Parks. Space 135.

Morden Frog & Crossing Works, Chicago.—Unity switch stand operating distant signal and facing point switch with positive point lock. Parallel ground throw, G. L. M. switch stand, rigid manganese steel frogs; guard rail clamps; switch adjustments; rail braces; slide plates; track jacks; compromise joints, etc. Represented by J. T. Hartz, Arthur C. Smith, H. M. Macke, D. H. Cusic, W. J. Morden. Space 86.

National Electric Specialty Company, Toledo, O.—Vac-M lightning arresters. Represented by F. S. Chapman, R. M. Stover. Space 223.

Railway Specialty Company, Atchison, Kan.—Power device for setting screw spikes; also the Au-Tra-Kar, a self-propelling section car. Represented by C. Hastings.

Railway & Traction Supply Company, Chicago.—Hercules bumping posts, made by J. M. Scott & Sons, Racine, Wis.; automatic lock nuts, manufactured by Automatic Lock Nut Company, Rockford, Ill. Represented by J. M. Scott, E. E. Scott, Charles Rystrom, Cortlandt F. Ames. Space 115.

St. Louis Surfacer & Paint Company, St. Louis, Mo.—Metal surfacer paints and paint specialties. Represented by W. S. Avis. A. D. McAdam. Space 214.

CONSERVATION OF CROSS TIES BY MEANS OF PROTECTION FROM MECHANICAL WEAR.

By J. W. Kendrick, Vice-President, Atchison, Topeka & Santa Fe Railway System.

The following is from a fully illustrated paper presented by Mr. Kendrick at the annual meeting of the American Railway Enginering and Maintenance of Way Association: After discussing in detail the past and present consumption of ties and amount of timber available, he estimates the greatly increased sums which, at the present rates of development, must be spent for ties in 1920. He continues:

The developments of the past five years have proven that the railway officials of the country are alive to the fact that this very important problem requires immediate and earnest consideration. In fact, it affords one of the few great opportunities for enormous reduction in the expense of maintaining our railways. The average life of ties in the United States is about seven years, referring now to those that are not treated with some preservative against decay. Europe has practically demonstrated beyond a doubt that so far as decay is concerned it can be prevented for a period of twenty-five years or more.

An inspection made by E. O. Faulkner, in 1907, of a portion of the track of the Paris, Lyons & Mediterranean, over which 70 trains are run daily, resulted in the discovery of a large number of ties that show conclusively what can be achieved by proper methods. Most of these ties were of Baltic pine, and had been in use for 26 years. (Photographs are shown of one which was selected as a fair sample, is not decayed, and is still fit for many years of service.)

Cross ties remain in the tracks of European railways until they are removed for causes other than decay (i. e., because of mechanical wear), and afterwards serve for years for fence posts and other inferior purposes. True, European wheel and axle loads are much less than ours, but this fact has little to do with resistance of the ties against decay.

We in America have considered this problem because the facts of the past few years have forced its consideration upon us. We are passing through the experience of European railway men, who encountered the same problem in years now long passed and who have solved it successfully according to the requirements by which they were confronted. Our problem is measurably more difficult. We have to deal with conditions as to climate, precipitation, and so forth, which are limited by greater extremes than those ordinarily existing in European countries.

Again, we have to deal with quite different conditions as regards character and weight of locomotives and cars, conditions not conducive to durability of ties. Naturally, the wide experience of the managers of European railways and the methods that have been adopted and successfully pursued by them seem to indicate the course that we should follow. We should adapt their practice to our needs as far as possible until such time as something better can be found. There is no reason to suppose that ties properly treated will not resist decay in this country for an average of 25 years.

Decay may begin within the tie or attack it from without. Wood is subject to deterioration because of the attack of enemies of both the animal and the vegetable kingdom. The chief cause of deterioration of ties, aside from mechanical wear, is due to the penetration of the wood by vegetable spores which feed upon and cause the destruction of the wood cells. Many inquiries have been made as to the cause of cross tie failure. The anwers have been: because of decay about 75 per cent., because of rail cutting 25 per

cent. The writer believes that these figures are misleading; that more than 25 per cent. of ties are removed on account of what we generally term mechanical wear, and, in fact, mechanical wear so generally precedes decay that the cause of tie failure cannot be accurately asertained.

Mechanical wear, in rail cutting, and in killing or the disruption of the fibres by spikes, opens up the interior of the wood to the action of the fungi causing decay, hastening the process. Decay of course breaks down the structure of the wood and weakens it beyond the power to withstand mechanical wear. The two processes of tie destruction facilitate each other. Mechanical wear thus undoubtedly hastens decay, and reduces the life by several years.

Some 18 or 20 years ago the subject of the protection of ties against rail cutting was actively introduced and as the weight of locomotives and cars was increased, and the necessity for tie protection became apparent, tie plates were gradually adopted. Then, as now, and as it will be in the future, the element of first cost in connection with a new and untried device of unknown merit was a matter of prime consideration. It is well known to everyone that the tie plates of 18 or 20 years ago were entirely inadequate. They shriveled under the weight imposed upon them as the green leaf does under the influence of frost. Like the leaf they disintegrated. The finely spun theories about the plate becoming part of the tie because its ribs or flanges, were forced into the grain of the wood, were dissipated by the inexorable demonstrations of practical experience. The wood composing the tie invariably developed a cross check coincident with the penetration of the ribs or flanges, and the rail rested upon a bent, buckled, or broken, sheet of pressed or cast metal, which in turn rested unstably upon a disintegrated mass of wood fiber, and into the cavity thus formed water entered, decay spores followed and the days of the cross tie so armored were practically numbered. The lesson of experience are only learned at great cost.

Even supposing the tie plate to be effective, the question of primary expense was still to be considered. The cost of timber was still relatively cheap, very cheap, in fact. The time for facing the problem in its entirety had not yet arrived; and so by various stages the railways of the United States year after year, or at intervals of a few years, changed the type of the metallic tie protection, or tie plate, and grudgingly increased its strength and area.

In view of the fact that this country had passed through many years of experience with timber bridges, that the properties of timber had been investigated by engineers and scientists, that its ability to resist compression, and so forth, had been demonstrated, had been accepted, had been taught in our engineering schools, it seems strange that anyone should have thought that a piece of metal of such inadequate area could transmit pressures, approximately determined, without crushing the wood fiber, or that, knowing as we did, and have known for more than 20 years, the properties of steel and iron, their capability for transmitting stresses or pressures without destruction, we should have provided for conditions more unfavorable than those which ever existed in any properly constructed bridge, such ridiculously inadequate metallic bearing and transmitting agencies as those that we adopted, and upon which the railways of this country have spent millions of dollars. Yet that is what we did.

The English engineer uses a heavy cast iron chair of ample size. The Continental engineer favors a rolled plate, but they are adequate for the purpose for which they are intended, and the tie removed from the track of the Paris, Lyons & Mediterranean after 26 years of service still sound, and apparently in as good condition so far as decay is concerned as it ever was, shows only the imprint of the tie plate upon the timber, and this tie was not selected because it was in exceptional condition, but was one of many that looked alike, and is only a fair sample of other ties that were inserted at the same time. The tie plate, as used in the United States, has in many cases been a destructive rather than a preservative agent.

But the tie plate that has been, and too often is even now, is not the worst feature of our track. There are many elements that are bad; some are worse than others. Let us consider some of these elements. The statistics of the Forestry Service and the Department of Commerce and Labor for the last year show that about 18 per cent. of the ties used were sawed; the remainder were hewed. Hewed ties, like everything else, may be well or badly made. If they are badly made, the upper and lower faces are not plane surfaces. The mark of the axe is frequently in evidence. They are often crooked, especially in this latter day, when everything of which a tie can possibly be made is used.

If one walks the tracks of many of the railways of the country cross ties will be found which not many years ago would not have been accepted even as culls. Woods that were formerly excluded by terms and designations in specifications have become preferential. Many of the cross ties now inserted on certain roads where timber is scarce are not large enough to make first-class fence posts. Other ties are made of timber naturally crooked and without proper surface.

In order to secure good track a tie should have a supporting medium composed of proper ballast, should afford an upper plane surface for the support of rails, and, on important lines, should be protected from rail cutting by the introduction of tie plates of proper dimensions. If the surface of the tie is imperfect, the utility of the tie plate is diminished little or much, according to the bearing that it has upon the tie.

Granted that tie and tie plates are all that can be asked for theoretically and practically, we then proceed to spike the rail to the ties with 5½x9-16 inch (or whatever the size may be) spikes. These are driven well or badly, according to the varying skill of the trackmen, or to the care that they take.

Tie plates with ribs are used. It is impracticable to bed them in the wood with any rapidity and the trackmen are content with securing a bearing on the tie, leaving a space dependent upon the length of the flanges of the tie plate between its lower surface and the top surface of the tie. Thus such penetration as has been secured, is the result of some preliminary pounding with a spike maul and driving the spike home. On curves two spikes are frequently driven on the outside, and on track that is intended for high rates of speed, for passenger trains, and also for freight traffic, it is frequently the case that the rails are double spiked on both sides. The passage of loads over the the rails and the transmission of pressure upon the tie plates is relied upon to bed them in the wood. Then, of course, the spikes are slack and it is necessary to complete the driving after the tie plates are in place.

The roadbed of a railway is more or less elastic. All ties do not have the same bearing, this being dependent upon the area of the bottom surface of the tie, character of ballast and the extent to which it is tamped under the tie, so that even in the most perfect track only approximately stable conditions exist. It is a well known fact that each pair of wheels on the engine and on the cars that it hauls causes what is known as a "wave," an actual depression of the rail occurring at the point of application of the load imposed by each pair of wheels and a corresponding elevation taking place before and behind that pair of wheels, due to the flexure of the rail.

When the wheels are immediately over any particular tie the tendency is, of course, to cause the rail and the tie plate to sink into the tie and compress its fibers, whereas, in adjacent ties the tendency is to rise and exert an upward pressure on the head of the spike. As a consequence anyone who may walk the track of any railway in the United States will find comparatively few spikes that are in contact with the rails. Some of them lack a quarter of an inch to an inch or more from coming to a bearing on the base of the rails. Of course, it is the duty of the trackmen to drive those spikes home again, but it is a well-known fact that anything in the nature of a nail or spike that is once loosened after being driven will never fit as snugly as it did in the first place.

If ties are made of oak, or some other hardwood in which the elasticity and resistance to compression is considerable, the holding power of the spike is, of course, considerably more than in soft grain woods, but in the end the result is the same. It eventually becomes necesary to draw the spike and drive it in a new place. The hole which it formerly occupied may not be plugged. If it is plugged, the spike may be redriven in the place originally occupied, but the hole has been enlarged, moisture creeps in and the spores of the infectious fungi follow. Ties fail quite as much, if not more, from spike cutting as from rail cutting, and this is especially true where curvature is excessive and it is necesary to reline and regage the track at frequent intervals.

All foreign engineers and managers express surprise that the railway officials of the United States have not long ago adopted the screw spike, which has been in general use in Europe for many years.

The economical use of ties (a practical application of

"conservation") depends, first, upon their preservation; second, upon their proper manufacture or shaping for the service that they are to perform; third, upon the introduction in the case of heavy traffic lines of adequate metallic bearing agencies, or tie plates, to transmit the load from the comparatively narrow rail base to the wood; and fourth, upon a form of fastening, i. e., a screw spike, which will hold the rail closely to the bearing surface upon which it is to rest. If all of these conditions are not observed, the wave motion of the rail, together with the intermitten depression and lifting of the ties, and the sliding back and forth or sawing motion of the rails will speedily result in their destruction.

Again, when it becomes necessary at periods ranging from a few months up to seven or eight years to renew rails (we are speaking of main line service now) what happens? Usually the rail is of heavier section than that it replaces. The ties were already cut by rails of lighter section, having a narrower base, or, even if the rail is the same in section, the ties are nevertheless cut, and before the new rail can be placed (without going into detail, which is unnecessary for our purpose, in regard to the entire process of relaying), it is indispensible that the tie should be adzed. The labor is usually unskilled, and it is regrettable that it is becoming more so each year. The adzes speedily become dull. Some ties are practically uncut; others are cut by varying degrees up to perhaps an inch or two inches, and with dull tools an attempt is made to bring them to a proper surface to receive the new rails. The result is that they are mutilated, some of them are cut one-third through, depressions are formed which gather and hold moisture, the old spike holes, plugged or unplugged, are covered, or partially covered, by the base of the rail, spikes are driven in new places, and the ties are left in such a condition that they are peculiarly receptive to moisture and germs that cause decay.

You will find this condition of affairs on every railway in the United States. The question of the power of timber to resist compressive strain, which, as previously stated, was determined many years ago, having been entirely neglected, reliance is placed on increased width of rail base to prevent cutting. Various theories are entertained in regard to the non-necessity for using tie plates on tangents; if at all. Hundreds of thousands, yes, millions, of treated ties (soft wood) have been placed in track without protection from rail cutting, and only after they have been seriously damaged has the necessity for some protection against mechanical wear been acknowledged.

Why should we not consider the matter from a common sense standpoint? Why should we not first of all treat our ties so that we may reasonably expect them to last 25 years; then provide a sufficient metallic bearing surface under the rail to prevent mechanical wear, and size or surface the tie, if hewn, so as to make a perfect contact between it and the bearing surface of the tie plate which transmits the pressure incident to the load? Then if the tie plate is sufficiently strong to transmit the pressure, and if the rails are properly fastened to the ties by the best known means, a means the practicability of which has been proven for many years in European practice, why should we not get such service from our ties to make them last three times as long as under present conditions, and, if the problem is properly solved, even four times as long?

In considering this subject we have felt it desirable to traverse for ourselves ground that had already been covered, although that precaution might seem superfluous in view of the experience of foreign roads.

There have been many experiments tried for the purpose of demonstrating the effect of the use of certain varieties of spikes upon the fiber or grain of the woods into which they were driven, and experiments to determine their holding value, but as far as we know these experiments have been tried for the purpose of demonstrating the superiority of one cut spike as compared with another. Various people have advocated the adoption of a spike having a long taper point which would not so badly distort the wood fiber in passing through it. Others thought a triangular spike or bayonet section would be preferable to those now commonly used. Still others thought that a round spike with square shank and chiseled point would better meet the requirements, and this field has been very thoroughly exploited.

We do not know whether the same line of experiments that we tried had previously been conducted by anyone, but, at any rate, our experiments seem to justify the position that we take, that the use of the destructive cut spike, now universal on all American railways, should be discontinued. (Mr. Kendrick shows photographs illustrative of tests which he conducted with the utmost care in the laboratory of R. W. Hunt & Co. at Chicago.) The destructive effect of the spikes upon the timber is clearly shown, the wood fiber being crushed and distorted in varying degrees according to the kind of wood, kind of spike and whether or not the tie was bored before driving the spike. Other photographs show the results obtained in other tests made with ties in which screw spikes were inserted in wooden plugs, in accordance with European methods. Screw spikes may be inserted directly in the tie; or the tie may be bored and plugged for each spike that is to be applied. In these cases the fiber of the wood is practically undisturbed.

As before mentioned, it is a common practice in Europe to provide a wooden screw plug or dowel to receive the spike. The ties are bored with holes about 5½ inches long and 1½ inch in diameter. These holes are then threaded to about one inch pitch. The ties are then treated, usually with creosote, and the wood around the hole intended for the plugs is thoroughly impregnated. The plugs or dowels are also impregnated with creosote and are screwed home in the holes prepared for them, the tie is then sized and the tops of the plugs are smoothly cut off in the same operation. The number of spikes varies from two to four at each rail bearing.

The question may be asked, of what use are the plugs? In the first place, the boring of the tie previous to treatment makes it practicable to thoroughly impregnate it with a preservative against decay at the points where it is most vulnerable, namely, where the spikes are inserted, and where the wearing action of the tie plates and the rails occur.

But there is another very good reason which will be shown by the table which follows. Tests were made for the purpose of determining the resisting power of various kinds of spikes against withdrawal under various circumstances:

	Mean.	Maximum.
Square spike in unbored tie	4,558 lbs.	6.826 lbs.
Round spike in unbored tie	2,478 lbs.	6,066 lbs.
Square spike in bored tie	4,082 lbs.	5,810 lbs.
Round spike in bored tie	4,108 lbs.	6,940 lbs.
Screw spike in bored tie	6,916 lbs.	10,842 lbs.
Screw spike in oak plug	8,170 lbs.	9,724 lbs.

Of course the resistance of the driven spike as compared with the screw spike is very much greater, according to this table, than it would be after it had been used for a little while. After they are once loosened their power of resistance against an upward force would be much less. It will be observed that the resistance of the screw spike against withdrawal is much greater than of the others.

A series of tests were made to determine the comparative crushing strength of ties with, and without, a certain number of plugs. Test "A" represents tie plate on tie without plugs; test "B," one with two plugs; and test "C," one with four plugs. The compression in inches under pressure of 80,000 lbs. was as follows:

Test:	1st Series.	2d Series.
"A"	2.69 in.	3.25 in.
"B"	1.03 in.	1.34 in
"C"	.97 in.	.87 in.

The only conclusion that can be reached as a result of these experiments is that the plug acts as a column, transmitting by means of its threads the pressure to which it is subjected through each layer of wood fibers, so that the pressure is distributed from top to bottom instead of being concentrated upon the top layer.

Regarding the Baltic pine tie taken from French track, to which reference has been made, it should be noted that after the first 10 years of service before the wooden tie plugs, or dowels, were inserted, the tie became rail cut. During the remaining 16 years' service, during which time the tie plate was used, the compression of the wood under the tie plate was very slight. This tie had four dowels, or spike holes. Although the penetration of creosote into the heartwood on the lower section of the tie was very slight, it has been sufficient to cause it to withstand decay, although, of course, the road is well ballasted and drained.

If ties serve their purpose for upwards of 25 years on European roads and are afterwards useful, as is the case, for fence posts and other purposes, there is no good reason why approximately the same longevity should not be ob-

tained in American practice. In order to secure this result it is necessary to:

First, treat the ties with some preservative to prevent decay.

In doing this first cost is of comparatively minor importance. The best proven treatment should be used, and there is no doubt that creosoting satisfies this requirement better than any other method. Ties may be fully creosoted, i. e., impregnated with all the creosote that the wood will take; they may be impregnated by the Rueping process, in which a portion of the creosote is extracted by exudation resulting from the expansion of the air forced into the wood cells during the process of treatment, and by the after application of a vacuum. They may be treated by a mixture of zinc chloride and creosote, or by any other method that is proven. It is not the purpose of the writer to discuss the relative merits of various methods of tie preservation. It seems sufficient to emphasize the necessity for using only such processes as have been proven. Proof does not depend upon actual practical use of ties in track. The growth of the fungus that produces decay can be stimulated, and results can be obtained in a few months that would require years of actual service to develop. The Atchison, Topeka & Santa Fe has adopted the Rueping process for the treatment of ties at its plant in Somerville, Texas, which has a capacity of about 2,500,000 ties annually. It uses crude oil with an asphaltum base at its plant in Albuquerque, N. M., which has a capacity of about 750,000 ties annually. The oil treatment is considered experimental, and its adoption was based upon the results obtained in its experimental track on the Beaumont division in southeastern Texas, where ties treated in this way were perfectly sound after a period of 5 years, and are still in that condition after the expiration of 7 years from the time of their insertion. Untreated ties made of the same wood placed in this track decayed within 9 months.

The Rueping process is rapidly taking the place of the full creosote treatment, which has been followed for years in Europe. This is especially true in Germany, where the relative value of treatment with various preservatives has been determined by exhaustive tests at Standal, and possibly at other places where similar plants are employed.

Second, tie plates of adequate length, width and thickness should be used in order to properly distribute the maximum pressures transmitted through the base of the rails to the upper surface of the ties.

The properties of various kinds of wood, with respect to their ability to resist compressive strains, have been determined repeatedly. As the majority of the ties that will be used in future will, as at present, be made of the soft and inferior varieties of wood, it is desirable to reduce the pressure upon the wood fibers to about 700 lbs. per square inch. The maximum weight on a single engine driving wheel is about 30,000 lbs. It will probably be sufficient if we add 50 per cent. to this to represent the effect of a suddenly applied load; in other words, to provide for the effect of impact. The rails and tie plates being securely fastened to the ties by screw spikes, the transmission of the effect due to the load on any wheel will be much more uniform than when cut spikes are used, in accordance with prevailing practice.

A flat-bottom tie plate which has been adopted, among others, by the A. T. & S. F., is 8¾ in. x 7½ in. and ½ in. thick. The effective area is therefore about 63 in., and the pressure on the tie incident to a load of 45,000 lbs. is just 700 lbs. per square inch. The thickness (one-half inch) has been found sufficient as a result of service under the heaviest power during a period of more than two years. It may be said that the width of this tie plate, 7½ in., will require a change in tie specifications, but in the interests of economy this change should be made. Narrower ties cannot be protected from wear, and, consequently, it will be unwise to go to the expense of treating them with preservatives. This tie plate has raised seats for the screw spike heads, designed to support the head of each spike in its entirety, and this is very necessary for the purpose of securing satisfactory results. It is arranged for four spikes, but only two are used in ordinary track.

Third, screw spikes should be so designed as to facilitate driving without injuring the shank.

Where spikes are driven by hand this is not so important, but the only reason for tapering the head is the fancied advantage in forging the spikes. It is practicable to forge them with cubical heads, and these are preferable. It is impracticable to apply screw spikes by hand in this country, without unnecessary expense, on account of the high wages that must be paid for labor, and the application of a machine driven tool to a truncated pyramidal head has been found to be difficult on account of the tendency of the tool to engage, then slip, so rounding the head as to impair its value for the purpose for which it is intended.

Fourth, it is desirable to introduce wooden screw dowels or plugs bored in the center to receive the screw spikes.

The office of these wooden dowels is referred to in a preceding paragraph. The tie should be bored and threaded to receive these plugs at the treating plant, and before treatment, as impregnation by the preservative generally will be very much more thorough than if these holes are prepared after treatment. This method of procedure is considered very important because it is impossible to secure the impregnation of heartwood by any preservative, at least to any great extent, and if the tie is treated first and bored afterwards, the portion which is unimpregnated will be opened for the admission of moisture, and fungi spores, which cause decay.

The plugs, or dowels, should also be impregnated before they are inserted. The bearing surface of the ties should be sized, and the plugs cut off at the same operation, to receive the tie plates, and thus insure proper and uniform bearing.

(Drawings show sections of ties in which wooden dowels have been inserted. See Railroad Age Gazette, December 24, 1909, p. 1231, where the track construction referred to below is described.)

The question will naturally be asked as to the relative cost of adopting this form of construction as compared with that now in use. A proper machine at the treating plant will bore and plug 600 ties with 8 plugs each, per day of 10 hours, at a cost of 3½ cents per tie. The cost of making the plugs will be about 1½ cents each. The cost of screw spikes will be 2.7 cents each; of tie plates 21 cents each. The cost of cut spikes will be 1.06 cents each. Assuming 3,000 ties per mile of track, with 4 spikes per tie, assuming that the same types of tie plates are used both with screw and cut spikes, and that 8 wooden dowels are provided for the plates with screw spikes, and no dowels are provided for cut spikes, the relative cost per mile of track would be as follows:

One Mile of Track With Screw Spikes and Dowels.

12,000 spikes at 2.7 cents each	$ 324
6,000 tie plates at 21 cents each	1,260
Boring ties for, and driving, 24,000 dowels, at 1 cent each	240
24,000 wooden dowels at 1½ cents each	360
Driving screw spikes (per mile)	150
Total	$2,334

One Mile With Cut Spikes.

12,000 spikes	$ 127
6,000 tie plates at 21 cents each	1,260
Driving cut spikes (per mile)	150
Total	$1,537

The difference in cost is considerable. The calculation assumes that tie plates will be used in either case, and true economy requires that this be done. The estimated cost of driving screw spikes is based upon work actually done under unfavorable conditions on a section of track about 5 miles in length, on the Illinois division of this railway, last fall. Unfortunately, the holes in the tie plates were a little too small, so that the screws acted as reamers to enlarge the holes before they could be driven home. The record of cost for driving 4,200 track feet—the best progress made in one day—indicated that there would be little or no difference between the cost of applying screw spikes and of driving cut spikes.

The element of increased cost is one which enters into any construction of superior type, and the real question is: Is it worth while? If this process is followed, the average life of ties on American railways would, very conservatively speaking, be 21 years instead of about 7, that is, they would last three times as long as at present. Screw spikes should be applied as ties are renewed. Then at the end of a period of from 7 to 10 years any line of railway pursuing this course would have provided its track with treated ties, screw spikes, and so forth. Let us consider what this would mean if the railway mileage of the United States were reconstructed in these respects:

Present (1910) trackage United States steam railways	350,000 miles
At present in track, about	1,000 million ties
Present annual requirements	150 million ties
Average trackage added per year for past 7 years	10,000 miles
Requiring yearly for new track	30 million ties
Present average life of ties	7 years
Requirements, assuming annual increase in trackage of 10,000 miles, for next 21 years	4,000 million ties

Corresponding to over 200 billion board feet timber, or 1-12th of our present standing forest.

Cost for 21 Years With Cut Spikes.

Present cost per tie, including treatment, tie plates, spikes, etc	\$1.00 to \$1.15
At present rate of increase in timber prices, cost as above, in 1931	\$1.75 to \$2.00
Average cost during next 21 years, approximately	\$1.55
Total investment in ties, present practice, to 1931	\$5,500,000,000

Cost for 21 Years, With Screw Spikes.

Present cost per tie, average only 20 cents more than for cut spikes.	
Average present cost	\$1.35
Average cost during next 21 years, if all renewals and new construction are made with screw spikes, approximately	\$1.65
Tie requirements to 1931, less than	1,600 million ties
Cost of same	\$3,500,000,000
Saving from use of screw spikes	\$2,000,000,000

These figures are sufficiently large to command respectful attention. They will be proportionately corrrect fo any mileage that may comprise any system, or any mileage that may be assumed. They may err in gross, because of the impossibility of determining the relative number of ties used in main lines, which should be so treated, and in yards, where such treatment would not be generally followed.

With the national timber supply only sufficient to last 30 years,* with the certainty that the cost of ties will increase more rapidly in the future than it has in the past, with the necessity for conserving the timber supply of the country in the interests of economy and in order that timber may be obtainable for purposes for which no other materials are suitable, there can be no question that the time has come when this very important problem should receive the serious attention of everyone having to do with maintenance of track. The saving that can be effected will represent an addition to the net earnings of the railways of the country. The total saving indicated by the above statements amounts to 4 per cent. upon the enormous sum of fifty billions of dollars.

That this method was not introduced and used long ago is due to the fact that the timber supply of the United States has, until late years, been constantly referred to as inexhaustible. Sinful waste has characterized its use. Various lands have been cut over and only the most desirable and soundest trees of chosen varieties have been taken. They have been cut over again and all the timber that was then merchantable has been removed. Again, for the third time, they have been cut over and practically everything that would make a lath has been removed and utilized. Sections of the country which are still blessed by the possession of extensive forests, are prodigal in the use of timber, but the time will come within the next decade, or certainly within the next 20 years, when there will be no such sections, and no one now living can foretell with any accuracy what the price of timber and ties will then be.

Other very important savings in connection with this method are those incident to the reduction in the enormous cost of transporting the greater number of ties that are now required as compared with the lesser number that will be required if the sensible and more economical practice of European countries is followed. The average haul of cross ties in 1905 being 500 miles, assuming the actual cost of transportation to the railroads to be 3 mills, the cost per tie transported was about 8 cents, and the cost of transporting the ties used annually, an average of 200 million for the next 21 years, would amount to \$16,000,000 per year. If the life of the tie be increased threefold, the cost of the transportation will be decreased almost to one-third of this amount, or to \$6,400,000 per year, and the difference between these two costs represents an annual saving to the railways of the United States of \$9,600,000, or about \$200,000,000 for the period.

Again, a common estimate of the cost of inserting a new tie is 15 cents. This includes all the operations necessary for removing the old tie, inserting a new one, and restoring the ballast. Applying the cost of 15 cents to the number of ties annually used results in showing a cost to the railways of the nation for removing old ones of \$30,000,000 annually, whereas, if the foregoing arguments are correct, this amount could be reduced to \$12,000,000; and, really, the saving of \$18,000,000 per year, or \$378,000,000 for the period of 21 years, constituting the difference between these two sums, does not represent the entire saving because the reballasting or resurfacing is not contemplated at the time of the tie insertion, but in the aggregate, vast indeterminate sums of money must be spent to restore the track to standard condition, subsequent to tie renewals.

These computations do not take into consideration the cost of providing the enormous number of cars and locomotives required for the transportation of ties, or a fair compensation to the railways for the use of such equipment. If they are not required for this purpose, it will either be possible to get along with less equipment or to use them for the transportation of revenue business.

The above computations, which show the apparent saving due to the adoption of a more rational and thorough system of track construction, do not take into account any interest charges which will properly accrue in connection with that portion of expenditures for ties used in construction, which are paid for with the proceeds from the sale of bonds.

The interest alone would amount to another vast indeterminate sum, according to the rate per cent., whether applied to the whole investment or only to that in new track, whether compounded, etc. In any case it would run into the hundreds of millions.

It may be said that some substitute will be found for wooden ties. If the figures representing the average cost of ties during a period of 21 years are correct—and that cost is \$1.55—there is very little probability that steel ties can be economically used. In the first place, they are not successfully used anywhere. Perhaps this statement is a little too positive, yet the testimony of American engineers who have investigated the subject abroad is to the effect that the men actually having to do with maintenance of track, even those who have had the longest experience with various types of steel ties, have very little to say in their favor.

It must be remembered, too, that the cost of steel is destined to increase, not in the same ratio as the cost of timber, perhaps—still it must increase appreciably. It is believed at the present time that all of the large existing bodies of ore have been located and approximately defined. If this is true, the exhaustion of these measures will be similar to that which must take place in our forest supplies. The coal measures of the United States, and the tonnage that can be extracted therefrom, can be computed at the present time with comparative accuracy. Without doubt, the cost of coal must increase, and if it is also true, of which there can be no doubt, that the consumption of steel will increase enormously, its cost is bound to be higher. Of course, a satisfactory steel tie will be found, but the writer believes that it will be a combination tie made of steel and wood. If so, the problems of tie preservation and protection against mechanical wear will be similar to those which must be considered in connection with ties made entirely of wood.

No success has attended efforts to make ties of concrete, and if such a tie is finally constructed it must, in the opinion of the writer, be as a result of a combination of steel, concrete and wood, or some fiber which will afford the elasticity necessary to prevent the destruction of the rails.

The purpose of this paper is to draw attention to the magnitude of the problem, to its vastness. Some better and cheaper method of accomplishing the ends herein referred to may be discovered, but none has been, and the writer presents the problem to the American Railway Engineering and Maintenance of Way Association for consideration, with the hope that its study will result in the invention of expedients and methods superior to those suggested.

*Gifford Pinchot's Estimate; see The Outlook, October 12, 1907.

THE STRAIGHT PUSH SASH OPERATOR.

The G. Drouve Company, Bridgeport Conn., in space 158, is showing a complete working model of the straight-push sash operator. This model was completed just previous of this convention, and is being shown for the first time. A full-size section of the operator is also shown, which, with the model, gives an excellent idea of the device.

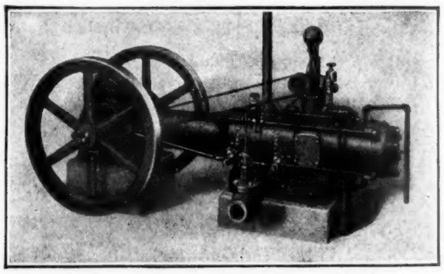
It can be applied to open or close, any number of sash from one control, being designed to meet practically any condition found in industrial buildings, steam or electric railway shops, power houses, foundries, etc.

The main features of this operator are two arms ½-in. steel rods, to each sash; guide and main lever of ¼-in.; pipe shafts, ¾-in. wrought steel, dowel connected; supporting brackets, cast iron spools, bearing shafts of phosphor bronze; operating wheel, with cast iron gears and steel shaft, controlling malleable iron rack and pinion.

All heavy substantial parts have phosphor bronze washers between rivet connections, as a protection against rust. Large rivets are used and all joints are flat. As there are no intricate parts, ease in placing and speed in operation is assured.

FRANKLIN GAS DRIVEN AIR COMPRESSOR.

The Chicago Pneumatic Tool Co., Chicago, has recently placed upon the market, a gasoline-driven air compressor, for which the company claims increased speed and greater efficiency. This is said to be made possible by the improved valve action and an oiling system which insures perfect lubrication. This new design affords minimum resistance, and overcomes gasket troubles. It is built in capacities of 75, 100 and 150 cu. ft. of air at one 100 lbs. pressure. It is simple in construction and operation, moderate in first costs and economical in maintenance. Being self-contained, it is especially adapted for yard work, tank building and general structural work.

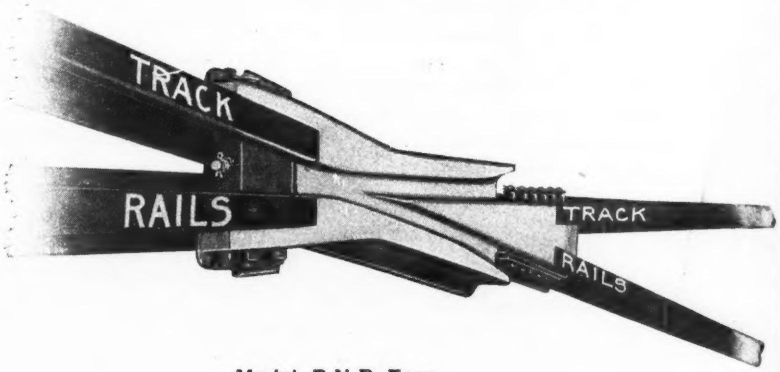


Gasoline-Driven Air Compressor.

Hitherto, when equipping cars, for maintenance bridges and buildings, the common practice has been to use a compressor belted to one of the standard gas engines, requiring large floor space. This new Franklin compressor can be accommodated in one-third of the usual floor space, and, being self-contained, can be readily removed from the car and placed where required.

MODEL R-N-R FROG.

The Indianapolis Switch & Frog Co., Springfield, Ohio, has specialized on solid manganese construction for frogs and crossings. By the elimination of the bolted construction, the company claims that the best efficiency is obtained. One of the company's special designs, the Model R-N-R railway frog, is shown in in space 182. This is a solid manganese frog, requiring no renewals during the life of the manganese. The track rails connect directly to the frog proper, without alteration. Only one pair of splices are required, instead of four, and all rails are protected by manganese easers so that it is claimed, all joint and point pounding is eliminated, also that the frog is smooth riding, noiseless and lasting.



Model R-N-R Frog.

The company shows one of these frogs which has been subjected to 165 blows by a 1,250 and a 2,500-lb weight, aggregating 1,679,375 ft. This test piece illustrates the physical properties of this manganese, which is made by the American Brake Shoe & Foundry Co., Mahwah, N. J., and under the supervision of W. G. Nichols.

All these frogs and crossing parts are tested before being placed in track.

MANGANESE STEEL FROG.

The accompanying cut shows one of the 86 manganese steel frogs being built by the Morden Frog & Crossing Works, Chicago, for the new Chicago & Northwestern terminal. These frogs are reinforced with 1½-in. D-bar straps on each side and are made of 100-lb. A. R. A. type B, open-hearth rails.

These manganese frogs have met with success in many places. The Illinois Central placed nine of them in track over three years ago, replacing Bessemer frogs that were worn out in three months under the heavy switching service. The nine manganese frogs are still in use, and on last inspection apparently had many months of life still in them.

The Morden Frog & Crossing Company is exhibiting in booth 86 at the Coliseum.

Manganese Steel Frog.

MARGULIES BAND.

The following is the program that will be rendered by Margulies' Band at the Coliseum today:

AFTERNOON.

March—Fighting Hope .... Maurice
Overture—Fest .... Leutner
Waltz—Tales from the Vienna Woods .... Strauss
Selection—The Army Chaplain .... Millocker
The Glow Worm .... Linke
Patrol—American .... Tobani
Darkies' Jubilee .... Turner
Spring Song .... Mendelssohn
Invitation a la Valse .... Weber
March—Gates City .... Weldon

EVENING.

March—Great Divide .... Maurice
Overture—La Gaza Ladra .... Rossini
Put on Your Old Gray Bonnet .... Wenrick
Quartette from Rigoletto .... Verdi
March—That Dreamy Rag .... Adler
Selection—Martha .... Flotow
Waltz—Southern Roses .... Strauss
Sextette from "Lucia" .... Donizetti
The Guardmount .... Eilenberg
March—Dublin Daisies .... Wenrich

RECENT INSTALLATIONS OF STRAUSS MOVABLE BRIDGES.

The Strauss Bascule & Concrete Bridge Company, Chicago, whose exhibit is in booth 157 at the Coliseum, is building a movable bridge for the Chicago & Western Indiana over the Calumet river at 125th street, Chicago. It is the first of two double-track, single-leaf bascule spans for this crossing. The leaf in this bridge is 186 ft. long, and the live-load capacity E-50, making it one of the largest and heaviest of bascule bridges on main-line railways. The operating equipment comprises a 30-h.p. oil engine, with a 22-kw. generator and the necessary storage battery, and also two 65-h.p. operating motors, a 25-h.p auxiliary motor and a 3-h.p. lock motor. The operator's house is of reinforced concrete, three stories in height, of fireproof construction throughout. The bridge will be used jointly by five trunk lines and is being built by the American Bridge Company.

There are four other bridges of the same type under construction at the present time, for the Peoria & Pekin Union Ry., the Northern Pacific Ry., the New York, New Haven & Hartford Railroad and the Transcontinental Ry. of Canada.

The company recently finished a bridge at Green Bay, Wis., over the Fox river, which presented unusual difficulties, as the piers rest on 70 ft. of mud and the river is very treacherous. The bridge consists of a bascule span and six approach spans.

A similar structure has recently been built over the Illinois river at Ottawa, Ill. It was designed as a bascule span, but only the parts necessary to carry the loads as a fixed span were erected, and the parts necessary to make it movable will be added when the river is made navigable by the opening of the Lakes-to-Gulf waterway.

The Florida East Coast Railway has recently completed a bascule bridge at Laudervale, Fla., which is of a new desgn. The span is designed on the lines of an ordinary deck plate girder span, and counterweight and mechanism for raising the bridge are attached at one end. The Florida East Coast bridge is a single-track structure of 63-ft. 6-in. span, and is opened by hand in one-half minute. A similar bridge with a span of 73 ft. has been built for the Ohio Electric Company at Toledo, O., another with a 96-ft. span at Winnipeg, Man. This new type has proven very successful where a deck construction is desired.

MAKING A DAILY TECHNICAL NEWSPAPER.

The work of getting out a daily technical morning newspaper is vastly different from that of getting out an ordinary daily morning newspaper. The ordinary daily newspaper has a large staff of editors, reporters, copy readers, printers, foremen, pressmen and binders, who are thoroughly trained to this kind of work. They are used to the idea that what can't be done today for tomorrow's paper can never be done. They work on the theory that it is far better to report a thing wrong today than to report it right tomorrow, because the average reader won't know whether a "story" is right or not, anyway. The technical daily newspaper, on the other hand, is edited and printed by men who are not used, every day of their lives, to rush work. Furthermore, it is read by technical men who are used to exact statements and exact work, and to whom a journal that does not get things right is so much wasted print paper. Between the necessity of rushing work as fast as the regular daily newspaper men, and of getting their copy as nearly as exact as a blue print as possible, the editors of a daily technical paper have an exceedingly hard job. In order to enable them to do it right, a well-nigh perfect organization, welded together by the most perfect spirit of co-operation, and impelled by great enthusiasm, is required. As to whether the results show that the Daily Railway Age Gazette has such an organization, composed of men united by such a spirit of co-operation and inspired by such enthusiasm, the reader is the best judge.

The object in printing this article is to give the layman a bird's-eye view of what it means to get out four consecutive daily issues of a morning newspaper made up largely of high-class engineering matter.

In the regular routine of the Railway Age Gazette, weekly edition, the staff is divided into two departments—editorial and business. The former has to do only with the matter that goes into the reading pages; while the business department concerns itself only with the advertising pages and the general executive work of the company. In the case of the Maintenance of Way Daily, the work of soliciting advertising is finished one week before the convention opens. The business department staff is then divided into three parts; one to assist the editors, another to circulate the papers, and a third to make up and supervise the work of printing the advertising pages.

The labor involved in getting out the Daily is not of a week or a month, but of several months. In fact, as this is the first time a publication of this kind has been attempted in connection with the conventions of the American Railway Engineering and Maintenance of Way Association, the plan and scope had to be worked out nearly one year ago.

With the planning, the work of the business department begins. This year much educational work, which will be unnecessary another year, had to be done. Then started, simultaneously, the business of soliciting advertising and gathering together the materials consumed in printing the paper.

Providing for the presswork, binding and mailing involves hundreds of details of no special interest to the reader; but they all require constant attention. For instance, all paper used in printing the Daily had to be made to order. Eleven tons were necessary; and it differs so in quality and size

from the usual run of printing paper that it cannot be bought in the regular market. The cover stock had to be made at one mill and the white paper at another mill. The order then had to be duplicated to insure prompt replacement by express in the event of a wreck en route or a fire after delivry at the press rooms. Fifty thousand envelopes had to be made and printed in a certain way to conform with the postal regulations. They were then shipped from the factory to our New York office, put through the addressing machines, sorted geographically for mailing, reboxed and shipped here by express. And so on, from selecting the proper plant in which to do the mechanical work, to providing offices in the hotel and Coliseum and living accommodations for such members of our staff as we must bring to Chicago from our other offices.

To procure the best possible current comment on the work of the convention, two members of the staff, Mr. Forsyth and Mr. Fowler, attend all sessions and prepare editorial notes. The paper has also been fortunate in obtaining direct co-operation in the form of editorial paragraphs from Messrs. Hunter McDonald, Charles S. Churchill, C. H. Cartlidge, M. L. Byers, L. C. Fritch, W. W. Colpitts, O. P. Chamberlain, Franklin E. Abbott, J. A. Lahmer, Azel Ames, W. H. Arkenburgh, Professor C. Frank Allen, Professor W. K. Hatt, Professor Walter L. Webb, Professor William G. Raymond and Professor W. D. Pence.

Apart from the leading editorial pages, the Daily is made up of convention proceedings and reports, "conventionalities," and descriptions of the exhibits at the Coliseum. Where the sessions of the convention last until 11 or 12 at

Workers on the Maintenance of Way Daily.

night the work of making a full and accurate report and getting it edited, printed and distributed by 6 in the morning is a first-rate task. Expert convention stenographers, in charge of T. E. Crossman, work in relays, and two editors, Bradford Boardman and H. H. Simmons, handle their copy leaf by leaf, passing it through to the managing editor, Ray Morris, who is responsible for its appearance in the paper.

Two editors, F. W. Lane and Samuel O. Dunn, handle the "conventionalities"; two others, F. E. Lister and F. S. Dinsmore, the latter temporarily detached for this purpose from the business department, handle news of the exhibit, and they are assisted by the entire business staff, which has direct responsibility for the brief descriptions of the Coliseum exhibits. The Railway Age Gazette automobile runs all day long between the editorial office, at the Congress Hotel, the

Aside from the preliminary educational work and planning, it took a considerable part of the time and energy of the business department for two and one-half months.

Two-thirty o'clock on the afternoon of Sunday, March 13, found just twenty regular staff members assembled at their desks in the Railway Age Gazette Daily office in the Congress Hotel, in executive session perfecting plans for four of the most strenuous days they will have had since last June, when we edited seven daily issues in Atlantic City, printed them in New York, and had them on the breakfast tables at Atlantic City every morning. At this Sunday meeting every man was assigned to specific work; and for the first time since the 1909 M. M. and M. C. B. conventions, the forces of both departments were interwoven to expedite the exact work.

Coliseum, and the printing shop of the Blakely Printing Company, where the Daily is printed, and serves to co-ordinate the work of the editorial office, the Coliseum office, and W. E. Hooper, the make-up editor, at the printer's.

In the editing of any daily it is the unexpected that usually happens. This Daily is no exception. No foresight can tell what is going to happen many minutes ahead. The managing editor cannot anticipate when any specified report is going to be reached. He cannot anticipate how long or important the discussion on the report will be. He cannot tell when one of the editors will bring in a long "must" story. He cannot know when one of the linotypes or presses at the printing office, or the automobiles, with the uncertain and refractory disposition characteristic of all linotypes, presses and automobiles, will balk. But up to this writing neither man nor machine has refused to pull its share of the load, and no signal of distress has yet been run up indicating that any such calamity is going to happen.

The moment the make-up editor O.K.'s the last page of reading matter for press, the entire responsibility for conforming to the rest of the schedule is assumed by the business department.

Henry Lee is in direct charge of the advertising make-up and presswork. The last advertising form is running through the press about the time the first form of text matter is sent "down stairs." It is his job to watch the run-off of the first one thousand sheets of every form, so that the convention distribution is assured before he goes to bed. Yesterday morning he said "goodnight" at 3 a. m. At present writing, with a meeting scheduled to adjourn at 11 o'clock Tuesday night, it means 5 a. m.; and he will have had just one and one-half hours' sleep since 7 a. m. Monday. But that's only an incident of our sertnuous life.

The printed sheets take their usual course through the folding, stitching and trimming machines and one thousand copies are tied in packages by 6 o'clock a. m. At that exact moment a Railway Age Gazette automobile containing L. B. Sherman and two messengers stops at Blakely's; the packages of Dailies are put aboard and the work of local distribution begins. With a carefully compiled registration list as a guide, copies of the Daily are in the boxes or at the doors of the rooms of every railway man registered at a hotel or club in Chicago, before 7 o'clock. A corps of messenger boys starts out at 7 a. m., and copies of the Daily are placed by them on the desks of every railway officer in the down-town district who is a regular subscriber to the Railway Age Gazette—and there are several hundred in that particular district. The rest of the run is then mailed to all regular subscribers in North America.

All the executive work and all the work of the members of the business department is directed by the vice-president, Edward A. Simmons. He is the general burden bearer and is subject to call at all times of the day and night. These burdens, however, are no greater than the specific burdens of each and every member of the entire staff. And the best of it all is, that every one of them enjoys his work.

REGISTRATION — MAINTENANCE OF WAY ASSOCIATION.

Allen, C. Frank, Prof. R. R. Eng., Mass. Inst. Tech., Boston, Mass.
Ambrose, J. R. W., Asst. Eng., Grand Trunk Ry., Montreal, Can.
Ames, Azel, Jr., Kerite Insulated Wire & Cable Co., New York.
Anthony, C. C., Asst. Sig. Eng., P. R. R., Philadelphia, Pa.
Anthony, F. D., Montreal, Can.
Armour, Robert, Asst. Eng., Grand Trunk Ry., Montreal, Can.
Armstrong, H. J., Asst. Prof. C. E., Armour Inst., Chicago.
Arthur, G. F., Assistant Engineer, I. C. R. R., Fulton, Ky.
Atwood, J. A., Chief Eng. P. & L. E. R. R., Pittsburg, Pa.
Atwood, Wm. G., Chief Engineer, L. E. & W. R. R., Indianapolis.
Backes, W. J., Chief Eng., Cent. New Eng. Ry., Hartford, Conn.
Bagg, F. A., Eng. F. J. & G. R. R., Gloversville, N. Y.
Beagles, Fred., Asst. Eng., O. R. R. & N. Co., Portland, Ore.
Begien, R. N., Div. Eng., B. & O. R. R., Philadelphia.
Bergen, W. J., Asst. to C. E., N. Y. C. & St. L. Ry., Cleveland.
Beye, John C., Loc. Eng., C., R. I. & P. Ry., Chicago, Ill.
Blaiklock, M. S., Eng. M. of W., Grand Trunk Ry., Montreal, Can.
Bostwick, W. A., Metallurgist, Carnegie Steel Co., Pittsburg.
Bowser, E. H., Chief Timber Insp., I. C. R. R., Memphis, Tenn.
Boyd, G. E., Roadmaster, I. C. R. R., Chicago, Ill.
Bremner, Geo. H., Eng. Ill. Dist., C., B. & Q. R. R., Chicago.
Brimson, C. T., Eng. M. W., Q. O. & K. C. Ry., Kansas City.
Brimson, W. G., V.-P. and G. M., Q. O. & K. C., Kansas City.
Brooke, G. D., Div. Eng., B. & O. R. R., Baltimore, Md.
Brown, J. M., Dist. Eng., C., R. I. & P. Ry., Davenport, Ia.
Burgess, G. H., Chief Eng., D. & H. Co., Albany, N. Y.
Burke, James, E. M. W., Erie R. R., Cleveland, O.
Burpee, Moses, Chief Eng., B. & A. R. R., Houlton, Me.
Burpee, T. C., Eng. M. W., Intercolonial Ry., Moncton, N. B.
Burton, W. J., Div. Eng., Mo. Pac., Ry., St. Louis, Mo.
Bush, Lincoln, Cons. Eng., Metropolitan Life Bldg., New York.
Byers, M. C., Chief Eng.-Operation, St. L. & S. F., St. Louis.
Camp, W. M., Editor Railway & Eng. Review, Chicago, Ill.
Cantine, E. I., Div. Eng., D. L. & W. R. R., Hoboken, N. J.
Cartlidge, C. H., Bridge Eng. C., B. & Q. R. R., Chicago, Ill.
Chandler, Charles, Bridge Engineer, C. G. W. R. R., Chicago.
Chanute, O., Consulting Engineer, Chicago, Ill.
Christofferson, C. A., Signal Eng., N. P. Ry., St. Paul, Minn.
Church, H. M., Div. Eng., B. & O. S. W. R. R., Cincinnati, O.
Churchill, Chas. S. (Director), Chief Engineer N. & W. Ry., Roanoke, Va.
Clausen, L. R., Supt., C., M. & St. P. Ry., Chicago, Ill.
Clement, S. B., Chief Eng. T. & N. O. Ry., North Bay, Ont.
Coates, F. R., V. P. Interocean Steel Company, Chicago, Ill.
Coburn, Maurice, Prin. Asst. Eng., Vandalia Line, St. Louis, Mo.
Colby, J. A., Insp. Eng., Philadelphia, Pa.
Condron, T. L., Consulting Eng., Monadnock Block, Chicago.
Conner, J. K., First Asst. Eng., L. E. & W. R. R., Indianapolis.
Cook, C. C., B. & O. R. R., Morgantown, W. Va.
Correll, E. J., Eng. M. W., Mo. Pac. Ry., Little Rock, Ark.
Courtenay, W. H., Chief Eng. L. & N. R. R., Louisville, Ky.
Cox, J. B., Consulting Engineer, Chicago, Ill.
Crandall, C. L., Prof. of Ry. Eng., Cornell Univ., Ithaca, N. Y.
Crumpton, Arthur, Asst. Eng., G. T. Ry., Montreal, Can.
Cunningham, A. O., Chief Eng., Wabash R. R., St. Louis, Mo.
Curd, W. C., Asst. Eng., Mo. Pac. Ry., St. Louis, Mo.
Curtis, L. G., Div. Eng., B. & O. R. R., Chicago, Ill
Curtis, W. W., Consulting Eng., Chicago, Ill.
Cushing, W. C., (Second Vice-President), Chief Eng. M. of W. S. W. Sys., Penna. Lines, Pittsburg, Pa.
Dakin, A. H., Jr., Cons. Eng., 370 St. Nicholas Ave., New York.
Davidson, Geo. M., Chemist & Eng. Tests, C. & N.-W. Ry., Chicago.
Davis, C. A., Eng. Dept., C. B. & Q. R. R., Lincoln, Neb.
Davis, C. S., Consulting Engineer, Toledo, Ohio
Davis, Garrett, Superintendent, C., R. I. & P. Ry., Elden, Mo.
Dawley, W. M., Asst. Eng., Erie R. R., New York.
Dorley, A. F., Div. Engineer, Mo. Pac. Ry., Kansas City, Mo.
Dougherty, C., Engineer M. W., C. N. O. & T. P. Ry., Cincinnati.
Douglas, H. T., Jr., Chief Eng., W. & L. E. R. R., Cleveland.
Downs, J. L., Roadmaster, Y. & M. V. Ry., Vicksburg, Miss.
Downs, L. A., Asst. to Chief Eng. M. of W., I. C. R. R., Chicago.
Dunham, Chas., Signal Eng., Gt. Northern Ry., St. Paul, Minn.
Eck, W. J., Electrical Eng., Sou. Ry., Washington, D. C.
Elliott, W. H., Signal Eng., N. Y. C. & H. R. R. R., Albany, N.Y.
Entwisle, E. B., Ch. Eng., J. & S. C. R. R., Johnstown, Pa.
Ewing, C. H., E. M. W., P. & R. Ry., Reading, Pa.
Fake, C. H., Chief Eng. M. R. & B. T. Ry., Bonne Terre, Mo.
Faulkner, E. O., Man. T. & T. Dept., Santa Fe., Topeka.
Ferriday, Robert, E. M. W., Big Four Ry., Indianapolis, Ind.
Finke, W. F. H., Tie and Timber Agt., Sou. Ry., Washington, D. C.
Fisk, C. H., Consulting Engineer, St. Louis, Mo.
Fithian, C. B., Div. Eng., M. P. Ry., Van Buren, Ark.
Fritch, E. H. (Secretary), 962 Monadnock, Chicago.
Fritch, L. C. (First Vice-President), Chief Engineer, Chicago Great Western Railroad, Chicago, Ill.
Funk, A. M., Division Eng., B. & O. R. R., Newcastle, Pa.

Gerber, W. D., Consulting Eng., Chicago, Ill.
Going, A. S., Locating Eng., Grand Trunk Ry., Montreal, Can.
Greiner, J. E., Consulting Eng., B. & O. R. R., Baltimore, Md.
Griswold, H. C., Asst. Inspecting Eng., I. St. Co., Chicago, Ill.
Hale, H. E., Prin. Asst. Eng., Missouri Pacific Ry., St. Louis.
Hallsted, Jas. C., Consulting Engineer, Chicago.
Hanna, E. E., Div. Eng., Mo. Pac. Ry. Aurora, Mo.
Hatt, W. K., Prof. C. E., Purdue Univ., Lafayette, Ind .
Hendricks, V. K., Asst. E. M. W., St. L. & S. F. Ry., St. Louis.
Hill, C. C., Div. Eng., M. C. R. R., Niles, Mich.
Hotchkiss, L. J., Asst. Bridge Eng., C., B. & Q. R. R., Chicago.
Hovey, M. H., Wisconsin Railway Commission, Madison, Wis.
Howard, C. P., Eng. Dept., L. S. & M. S. Ry., Cleveland.
Hughes, Wm. M., Cons. Bridge Eng., Chicago, Ill.
Ibsen, Hans, Bridge Eng., M. C. R. R., Retroit. Mich.
Jacoby, H. S., Prof. of Bridge Eng., Cornell Univ., Ithaca, N.Y.
Jenkins, J. B., Asst. Eng. B. & O. R. R., Baltimore, Md.
Johns, C. W., Asst. Eng., C. & O. Ry., Hinton, W. Va.
Johnson, Thos. H., Consulting Eng., Pennsylvania Lines, Pittsburg.
Johnston, A. W., (Past President), Gen. Man. N. Y. C., & St. L. R. R., Cleveland, O.
Jordan, S. A., Eng. M. of W., B. & O. R. R., Baltimore, Md.
Kelley, Howard G. (Past-President), Chief Engineer, Grand Trunk Railway System, Montreal, Can.
Kenly, R. G., Eng. M. W., M. & St. L. R. R., Minneapolis.
Knickerbocker, C. E., E. M. W., N. Y., O. & W. Ry., Middletown, N. Y.
Lahmer, J. A., Prin. Asst., K. C. S. Ry., Kansas City, Mo.
Lane, E. G., E. M. W., B. & O. R. R., Pittsburg, Pa.
Lee Frank, Div. Eng., Can. Pac. Ry., Winnipeg, Man.
Leighty, John R., Div. Eng., Mo. Pac. Ry., Kansas City, Mo.
Lemond, J. S., Engineer M. W., Southern Ry., Charlotte, N. C.
Lewis, E. R., Div. Eng., M. C. R. R., Bay City, Mich.
Liggett, Thomas, Jr., Chief Eng., W. Allegheny R. R., New Castle, Pa.
Loweth, C. F. (Treasurer), Eng. & Supt. B. & B., C. M. & St. P. Ry., Chicago.
Lum, D. W., Ch. E. M. W. and Str., Sou. Ry., Washington, D. C.
McDonald, Hunter (Past-President), Chief Eng. N., C. & St. L. Ry., Nashville, Tenn.
McIntyre, L. J., Asst. Eng., Nor. Pac. Ry., St. Paul, Minn.
McNab, William (President), Principal Assistant Engineer, Grand Trunk Railway System, Montreal, Canada.
Macomb, J. de N., Jr., Eng. Dept., A. T. & S. F. Ry., Chicago.
Mann, B. H., Signal Eng. Mo. Pac. Ry. System, St. Louis, Mo.
Martin, L. B., Engineer M. W., Illinois Traction Co., Decatur, Ill.
Mather, Richard, Asst. Eng. Erie R. R., Cuba, N. Y.
Miller, C. H., Engineer River Prot., Mo. Pac. Ry., St. Louis, Mo.
Mitchell, W. M., Chief Engineer, K. & I. B. R. R. Co., Louisville.
Mock, J. C., Electrical Eng. Detroit River Tunnel Co., Detroit.
Modjeski, R., Cons. Eng., Monadnock Block, Chicago, Ill.
Monsarrat, C. N., Eng. of Bridges, C. P. Ry., Montreal, Can.
Montfort, R., Cons. Eng. L. & N. R. R., Louisville, Ky.
Montzheimer, A., Ch. E., E., J. & E. and C., L. S. & E., Joliet.
Moore, W. H., Br. Eng., N. Y. N. H. & H. R. R., New Haven.
Mordecai, Augustus, Consulting Engineer, Cleveland, Ohio.
Mountain, G. A., Chief. Eng. Can. Ry. Commission, Ottawa, Can.
Mullen, Joseph, E. M. W., C. C. C. & St. L. Ry., Mt. Carmel, Ill.
Myers, J. B., Div. Eng., B. & O. R. R., Cumberland, Md.
Neff, F. H., Prof. C. E. Case School Appl. Sci., Cleveland, O.
Nelson, J. C., E. M. W., S. A. Line, Norfolk, Va.
Newbegin, P. C., Maint. Eng., B. & A. R. R., Houlton, Me.
Osgood, Jos. O, Chief Eng., C. R. R., of N. J., New York.
Parker, W. A., Chief Eng., St. J. & G. I. Ry., St. Joseph, Mo.
Parrish, F. J., E. M. W., K. & I. B. & R. R. Co., Louisville, Ky.
Patenall, F. P., Signal Eng., B. & O. R. R., Baltimore, Md.
Patterson, J. C., Asst. C. E., Gr. Nor. Ry., St. Paul, Minn.
Patterson, F. M., Asst. Eng., C., B. & Q. R. R., Chicago, Ill.
Peabody, J. A., Signal Eng., C. & N.-W. Ry., Chicago, Ill.
Pelley, John, Roadmaster, I. C. R. R., McComb Miss.
Pence, W. D. (Editor of Publications), Prof. R. R. Eng., Univ. of Wis., Madison, Wis.
Philbin, T. R., Consulting Engineer, Chicago.
Puder, F. R., Asst. Eng., Chicago Sou. Ry., Chicago, Ill.
Quigley, C. N., Asst. Eng., M. C. R. R., Bay City, Mich.
Ransom, C. L., Res. Eng., C. & N.-W. Ry., Omaha, Neb.
Ray, G. J., Chief Eng., D., L. & W. R. R., Hoboken, N. J.
Raymer, A. R., Asst. Chief Eng., P. & L. E. R. R. Pittsburg, Pa.
Raymond, W. G., Dean, State Univ., of Iowa, Iowa City, Ia.
Rhea, Frank, General Electric Co., Schenectady, N. Y.
Rice, S. B., Roadmaster R. F. & P. R. R., Richmond, Va.
Richey, C. W., Master Carpenter, P. R. R., Pittsburg Pa.
Roach, J. H., Div. Eng., L. S. & M. S. Ry., Cleveland, O.
Roberts, S. S., Asst. Prof. R. R. Eng., Univ. of Ill., Urbana, Ill.
Robinson, A. F., Bridge Eng., Santa Fe Ry. System, Chicago.
Rohbock, W. L., Asst. to Ch. Eng., W. & L. E. R. R., Cleveland.
Rose, L. S., Signal Eng., Big Four Ry., Cincinnati, O.
Rote, R. O., Jr., Prin. Asst. Eng., L. S. & M. S., Cleveland, O.
Rowe, S. M., Con. Eng., Monadnock Block, Chicago, Ill.
Rudd, A. H. (Director), Signal Eng., P. R. R., Philadelphia.
Schulz, W. F., Eng. Dept., L. & N. R. R., Louisville, Ky.
Scott, G. E., 502 Fitzsimmons Bldg., Pittsburg, Pa.
Scribner, G. H., Jr., Contr. Engineer, Chicago, Ill.
Seddon, W. L., Chief Eng., Seaboard Air Line, Norfolk, Va.
Selby, O. E., Bridge Eng., C., C. C. & St. L. Ry., Cincinnati.
Shurtleff, A. K., Office Eng., C., R. I. & P. Ry., Chicago, Ill.
Smith, C. E., Asst. Eng., Mo. Pac. Ry., St. Louis, Mo.
Smith, C. H., Div Eng., N. Y. C. & St. L. R. R., Cleveland, O.
Smith, F. A., Civil Eng., Chicago, Ill.
Snow, J. P. (Director), Ch. Eng., Boston & Maine R. R., Boston.
Spencer, C. H., Eng., Washington Term. Co., Washington, D. C.
Sperry, H. M., Res. Man., Gen. Ry. Signal Co., New York.
Splitstone, C. H., East Orange, N. J.
Starbuck, R. D., Asst. Eng., M. C. R. R., Detroit, Mich.
Stein, C. H., Eng. M. of W., C. R. R. of N. J., Jersey City.
Steinbeck, E. J., Asst. Eng., I. C. R. R., Chicago, Ill.
Stern, I. F., Eng. Bridges, C. & N.-W. Ry., Chicago, Ill.
Stevens, F. S., Supt. P. & R. Ry., Reading, Pa.
Stevens, Thos. S., Signal Eng., Santa Fe System, Topeka, Kan.
Stimson, Earl, Ch. E. M. W., B. & O. S. W. R. R., Cincinnati.
Strouse, W. F., Assistant Engineer, B. & O. R. R., Baltimore, Md.
Sullivican, J. G., Asst. Chief Eng., C. P. Ry., Montreal, Can.
Swartz, Albert, Div. Eng., Erie R. R., Huntington Ind
Swingly, G. D., Div. Eng., B. & O. R. R., Connellsville, Pa.
Taussig, J. E., Ter. Supt. Wabash R. R., St. Louis, Mo.
Thompson, W. S., Asst. Eng., P. R. R., Sunbury, Pa.
Tinker, G. H., Br. Eng., N. Y. C. & St. L. Ry., Cleveland, O.
Tratman, E. E. R., Resident Editor Engineering News, Chicago, Ill.
Trench, W. I., Div. Eng., B. & O. S. W. R. R., Chillicothe, O.
Trimble, Robert, Ch. Eng. M. of W. N. W. Sys., Penna Lines, Pittsburg, Pa.
Turneaure, F. E., Dean, Col. of Engr., Univ. of Wis., Madison, Wis.
Wallace, W. A., Div. Eng., C., I. & L. Ry., Chicago, Ill.
Webb, G. H., Chief Eng., M. C. R. R., Detroit, Mich.
Webster, Wm. R., Cons. and Insp. Engineer, Philadelphia, Pa.
Weiss, H. F., Section Research, U. S. Forest Service, Madison.
Wendt, Edwin F. (Director), Asst. Eng., P. & L. E. R. R., Pittsburg, Pa.
Wentworth, C. C., Prin. Asst. Eng., N. & W. Ry., Roanoke, Va.
West, O. J., Res. Eng., Phoenix Bridge Co., Chicago, Ill.
Wheaton, F. L., Eng. Const., D. L. & W. R. R., Hoboken, N. J.
Wickhorst, M. H., Eng. of Tests, Rail Committee, Aurora, Ill.
Wilgus, H. S., Eng. M. of W., P. S. & N. R. R., Angelica, N. Y.
Wilson, C. A., Consulting Engineer, Cincinnati, O.
Wiltsee, W. P., Asst. Eng., N. & W. Ry., Roanoke, Va.
Wood, B. A., Chief Eng., M. & O. R. R., Mobile, Ala.
Young, R. C., Chief Eng., L. S. & I. and Munising Rys., Marquette, Mich.

GUESTS.

W. A. Fisher, Atlantic Coast Line.
F. W. Carrington, Indian Refining Co.
G. T. Warren, Ast. Div. Eng., B. & O. R. R.
Prof. F. O. Dufour, Univ. of Ill.
Prof. C. W. Malcomb, Univ. of Ill.
W. G. Nusz, Asst. Eng., I. C. R. R.
P. Aagaard, Supr., B. & B., I. C. R. R.
O. E. Strehlow, Ch. Eng., J. O. Heyworth Co.
J. R. Reinholdt, Div. R. M., M. & St. L. R. R.
O. R. Price, Asst. Eng., L. S. & M. S. Ry.
J. C. Mock, Elec. Eng., Detroit River Tunnel.
J. E. McNeil, Atlantic Coast Line.
R. Emerson, Eng. of Track Economics, A., T. & S. Fe Ry.
B. Wolhaupter, Rail Joint Co.
E. B. Temple, Asst. Ch. Eng. Penna. R. R.
H. W. Chase, Jos. Dixon Crucible Co.
E. R. Smith, Jos. Dixon Crucible Co.

SIGNALS AND INTERLOCKING.*

The board of direction assigned eight subjects:

1. Consider revision of Manual.
2. Continue investigation of outline and description of a comprehensive and uniform signal system, suitable for general adoption.
3. Continue preparation of standard agreement form for signal work, conferring with Special Committee on Uniform General Contract Forms. This agreement form should be general and should not include division of expense.
4. Confer with Committee III, on Ties, and make report on the effect of treated and metal ties on track circuits.
5. Report relative to proper form of switchstand signals, conferring with Committee V, on Track.
6. Confer with Committee IX, on Records and Accounts, relative to conventional symbols.
7. Revise Mechanical Interlocking Specifications presented in Bulletin 108, and include wrought-iron pipe as well as steel.
8. Review and re-submit Electric Interlocking Specifications, with statement of the results from experience.

A. H. RUDD.

Sub-committees were appointed as follows to handle the above subjects:

1—Sub-committee D: Eck, Temple and Wendt, chairman.

2—The entire committee with Sub-committee A, on special work of aspects, consisting of Messrs. Anthony, Cable, Mock, Patenall, Scott and Stevens, chairman, until May 20, and subsequent to that date, Cable, Ingalls, Patenall, Peabody, Scott and Anthony, chairman.

3—Sub-committee B: Harahan, Peabody, Rhea and Balliett, chairman.

4—Sub-committee G: Christofferson, Clausen, Hovey and Denney, chairman.

5—Sub-committee C: Taussig and Ingalls, chairman.

6—Sub-committee E: Ames, Ellis and Elliott, chairman.

7 and 8—Sub-committee F: Anthony, Patenall, Peabody, Stevens and Mock, chairman.

The committee makes changes and additions, the most important of which is matter adopted by the association since the Manual was last published and definitions from the revised Standard Code.

Uniform Signal System.

This report, with its conclusions, is similar to the one presented at the annual meeting of the Railway Signal Association last fall (Railroad Age Gazette, October 15 and 22, 1909), at which time, also, a minority report similar to the one mentioned below was presented by Messrs. Clausen and Stevens.

Standard Agreement for the Construction, Renewal, Maintenance and Operation of Joint Interlocking Plants.

On September 11 the chairman submitted to the chairman of the committee on Uniform General Contract Forms copies of agreements "A," "B" and "C," and asked that he check against these proposed agreements as instructed by the Board of Direction and supply his comments. No advice other than acknowledgment of receipt of papers has been received. Through oversight the Railway Signal Association committees were not instructed to prepare a table of the relative values of the various functions; this will be remedied during the current year, the instructions to the various committees interested being to submit lists of the comparative values to be given to the operating units with which each has to do, based on an arbitrary value of 10 for a one-arm three-position power operated signal, and it is hoped to have this information presented to the Railway Signal Association next October, so that it will be available for the use of this committee in time for its next report. The elimination of the division of expenses from the report as ordered by the 1909 convention emasculates the subject to such an extent that it is almost impossible to treat it intelligently or in a comprehensive manner. Considering all the circumstances, therefore, the committee feels that it is not in a position to make any definite recommendations this year and presents this explanation as a progress report.

Effects of Treated and Metal Ties on Track Circuits.

Committee III, on Ties, was notified of the appointment of the sub-committee, and did not arrange for a conference. It, therefore can only report progress.

Switchstands.

Last year a progress report only was presented, no conference being held, largely on account of the report of Committee X being accepted as a progress report. Members of this sub-committee were unable to attend a conference on the date arranged this year. Any delay must, therefore, be charged to Committee X.

Symbols.

The sub-committee held no meetings, as probably none will be necessary unless and until report on a uniform signal system is adopted.

Electrical and Mechanical Interlocking Specifications.

At the last convention the subject was referred back to the committee, with instructions to include wrought-iron pipe, as well as steel, and at the request of the committee the mechanical specifications were eliminated from the Manual.

Electric interlocking specifications were referred back to be revised and resubmitted with statements of the results of experience. In view of this attitude of the association, and of the numerous other subjects assigned to the committee, it was considered best to postpone the presentation of any specifications for a year or two in order that, as they had been adopted by the Railway Signal Association, they might be given a thorough trial, amended where necessary, and presented for adoption here just previous to the publication of the next Manual. The sub-committee, therefore, in conjunction with manufacturers and the chairmen of Railway Signal Association committees having these matters in charge, has occupied its time largely in harmonizing; making the specifications as far as possible identical in arrangement and wording.

The sub-committee has, in addition, prepared specifications for wrought-iron signal pipe, in conformity with the instructions of the association, voted at the 1909 convention. These specifications, however, have not been submitted to the committee as a whole, and have not been acted upon by the Railway Signal Association. Under these circumstances it has been considered best not to embody them in this report, and the sub-committee reports progress, which the entire committee endorses..

The report is signed by: A. H. Rudd (Penna. R. R.), chairman; Azel Ames (Kerite Insulated Wire & Cable Co.), C. C. Anthony (Penna. R. R.), H. S. Balliett (N. Y. C. & H. R.), H. S. Cable (C., R. I. & P.), C. A. Christofferson (Nor. Pac.), C. E. Denney (L. S. & M. S.), W. J. Eck (Southern), W. H. Elliott (N. Y. C. & H. R.), G. E. Ellis (Federal Signal Co.), M. H. Hovey (Amer. Ry. Signal Co.), A. S. Ingalls (L. S. & M. S.), J. C. Mock (Detroit River Tunnel), F. P. Patenall (B. & O.), J. A. Peabody (C. & N. W.), Frank Rhea (General Electric Co.), H. H. Temple (B. & O.) and Edwin F. Wendt (P. & L. E.).

The minority report, asking that the above report be referred back for further consideration, is signed by: L. R. Clausen (C., M. & St. P.), vice-chairman; W. B. Scott (Harriman Lines), Thomas S. Stevens (A., T. & S. F.) and J. E. Taussig (Wabash).

W. J. Harahan (Erie) does not concur in the majority report and does not sign the minority report.

*From a report presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association.

RULES AND ORGANIZATION.*

The committee was instructed to:

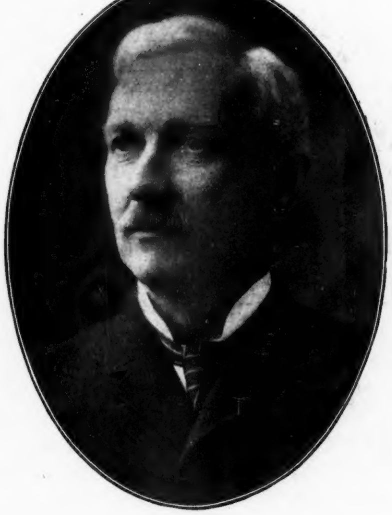
1. Consider revision of Manual, both generally and with a view to consistent general grouping of heads, uniformity of numbering and similarity in language covering similar rules.

2. Confer with allied committees which have heretofore presented rules which have been adopted by the association with a view of harmonizing all such rules as have been considered by this committee.

The work under the first instruction has mainly occupied the time of the committee, and this year's report does not attempt to deal with the second.

The General Rules for the government of employes of the maintenance of way department, heretofore adopted by the association, have been carefully reviewed by the committee, the revision being a more logical arrangement of the rules, and minor changes in wording without change in substance.

Some progress has been made, however, in compiling and arranging the rules originating with other committees, and it is proposed during the remaining months of the year to confer with such committees with a view to obtaining their assent to the changes in arrangement which may be found desirable.



J. O. OSGOOD.

The report then presents the rules as revised.

Conclusion.

The committee recommends that the revised general rules for the government of employes of the maintenance of way department, submitted herewith, be approved and incorporated in the Manual of Recommended Practice.

The report is signed by: Joseph O. Osgood (Cent. of N. J.), chairman; F. L. Nicholson (Nor. & Sou.), vice-chairman; C. C. Anthony (Penna.), F. D. Anthony (Que., Mont. & Sou.), M. S. Blaiklock (Grand Trunk), G. D. Brooke, B. & O.), W. H. Elliott (N. Y. C. & H R.), A. S. More (C., C., C. & St. L.), J. B. Myers, (B. & O.), and J. A. Peabody (C. & N. W.).

ELECTRICITY.†

This is a progress report. The following sub-committees have been appointed:

A—Clearances: L. C. Fritch, chairman; W. W. Drinker, G. A. Harwood.

B—Transmission Lines and Crossings: R. D. Coombs, chairman; A. S. Baldwin, G. A. Harwood.

C—Insulation: H. R. Talcott, chairman; R. D. Coombs, L. C. Fritch.

D—Maintenance Organization: J. B. Austin, Jr., chairman; E. P. Dawley, C. E. Lindsay.

E—Electrolysis: A. S. Baldwin, chairman; W. W. Drinker, H. R. Talcott.

F—Relation to Track Structures: C. E. Lindsay, chairman; J. B. Austin, Jr., E. P. Dawley.

These sub-committees were directed to prepare histories and bibliographies of the subjects considered, but in other respects each sub-committee will be permitted to conduct its investigations in the manner that the subject and conditions seem to make most desirable. At this meeting it was decided that the committee would meet bi-monthly.

Progress reports from the sub-committees have been made, as follows:

Sub-Committee A:

Reports of the Committee on Standard Location of Third Rail Working Conductors of the American Railway Association were discussed, and while no conclusion as to the amount of clearance which it would be advisable to recommend was agreed on, it was the sense of the sub-committee that the clearances between the limiting lines of equipment and the limiting lines of third rail structures, which are shown as 1½ inches in the report referred to, are insufficient, and that a greater clearance should be established. In order to determine the limiting clearance that could be established, it was decided to secure data showing limiting lines of clearances of third rail conductor structures, the limiting lines of rolling equipment and the limiting lines of third rail structures with respect to maintenance of way structures from various railways. The sub-committee is also collecting data from various railways electrified or partly electrified, and also interurban lines with heavy traffic, which may possible interchange with steam lines electrified or not electrified. This sub-committee is communicating direct with the representatives of the various railways, and a circular has also been issued by the secretary of the association, requesting data pertinent to the subjects outlined.

G. W. KITTRIDGE.

Sub-Committee B:

No meetings. Communications have been sent to various associations, suggesting the advisability of the various associations co-operating and requesting copies of their previous reports; copies of crossing specifications have also been requested from various companies. It is the intention to make report of comparison of the various specifications referred to. The secretary of the association has issued a circular requesting data pertinent to the subject.

Sub-Committee D and Sub-Committee F:

A circular letter of inquiry has been sent out to representatives of various railways that have substituted electricity for steam, wholly or in part, as a means of motive power.

The report is signed by: George W. Kittredge (N. Y. C. & H. R.), chairman; J. B. Austin, Jr. (Long Island), vice-chairman; A. S. Baldwin (Ill. Cent.), R. D. Coombs (Penna. Tun. & Term.), E. P. Dawley (consulting engineer), W. W. Drinker (Erie), L. C. Fritch (C. G. W.), G. A. Harwood (N. Y. C. & H. R.), C. E. Lindsay (N. Y. C. & H. R.), and H. R. Talcott (B. & O.).

*From a report presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association.
†From a report presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association.

Conventionalities

Did the man lisp who named those sliding fire-doors? He calls them "Allith."

L. R. Clausen, when he was signal engineer of the Chicago Milwaukee & St. Paul, was recognized as one of the wheel horses of the Railway Signal association. As superintendent of the Chicago division of the same road, he does not find it necessary to run away from his former pole-fellows, but, on the contrary, makes an admirable leader.

Constant Reader.—No, that is not a potato-digger, nor a vacuum cleaner that is exhibited by the Duntley Manufacturing Company—that is, it does not dig potatoes unless they are planted on the right-of-way, but it does create very much of a vacuum so far as weed-life along the track is concerned. It is admitted by manufacturers and users that it is better to use the machine before the weeds have gone to seed, though this is likely to injure the chances of the second crop.

Among the notable figures at the opening meeting was Octave Chanute, who divides his time between timber preservation and flying machines. If engineering is correctly defined as the utilization of the forces of nature for the benefit of man, Mr. Chanute has gone a little further than most of the members who are, indeed, sometimes "up in the air" temporarily, but are quite likely to be "in a hole" at the same time. The aeronauts appear to have solved the paradoxical situation by scooting off in the air and dragging the hole after them.

If there's a hole in a' ye'r coats
  I rede ye tent it;
A chiel's amang ye takin' notes,
  An', faith, he'll prent it.
—Burns.

An' ither holes ye may ha' had,
  An' ye ha' tented—
He'll speir about them, too—ye're glad
  To see them prented?

The spasmodic estheticism which occasionally catches Chicago, cropped out Monday in the issuance of an edict by some of Chief Steward's blue-coated and flat-footed minions requiring the removal of the streamers from the big red limousine which serves The Daily Railway Age Gazette as copy boy. This car makes trips from the Congress Hotel and Coliseum to the printing office on an hourly schedule from 6 a. m. to 2 a. m. and the aforesaid streamers afforded great joy to the A. D. T. boys who accompany the car.

But alas! for the joys
Of those A. D. T. boys
In the ribbons behind them so gallantly streaming,
The police have said: "No,
Those streamers don't go;"
And their joy-rides descend to the level of teaming.

Dr. W. Kendrick Hatt, chairman of the committee on "Wood Preservation," protessor of civil engineering, Purdue University, was among early arrivals on Monday. This association has always been particularly fortunate in the quantity and quality of active educational talent included in its membership, and it is believed to be no reflection upon the association to express the belief that however great the benefit derived from its proceedings by those members who are engaged in active educational work, its equivalent is fully returned in the amount of research and record work for which most of the latter have more ample facilities than the active railway engineer. Dr. Hatt is alleged to have a considerable amount of material in his traveling bag in addition to that which he carries in intimate relations with himself.

If any one of the twelve or fifteen men who met in a little club room half way up the stairs in the Auditorium ten years ago to take the initial steps for the formation of the American Railway Engineering and Maintenance of Way Association—if any one of them had ventured to predict a membership of 1,100 at the date of this meeting, he would have been looked upon as an exponent of wild-eyed optimism. It only means that the strong men who took hold of the job at the start were good pushers and possessed the enviable faculty of imparting some of their enthusiasm to those who came after them. It is pleasant to note, also, that so few of the smaller numbers have been vacated and that most of the same men are still in the lead in the work of pushing.

Daily newspapers have lately had a lot to say about a knocker who is trying to sell track appliances. Knowing the natural aversion of railway supplymen to "knockers," and learning that the knocker referred to in the published reports intends to be in Chicago this week, it becomes the duty of the Railway Age Gazette to do a little exposing. His name is Harry E. McCormick. He is with the queer and crazy—beg pardon; we mean the Q. & C. Co. The picture which we herewith produce as evidence of his professional calling, was taken both on the "fly" and just before the "fly." McCormick is a believer in "every knock is a boost," because he has proved the truth of the saying. Last year he knocked so hard that he nearly reached the top notch in professional baseball. Judging from what he has done so far this season in the way of selling rail joints, rail braces, rail saws and a lot of other track devices, he is destined to like success in the railway supply field.

PROGRAM FOR TODAY.

Morning session—9:00 a. m. to 12:30 p. m.
Afternoon session—2:00 p. m. to 5:30 p. m
Reports of Committees:
XVII. Wood Preservation.
III. Ties.
II. Ballast.
V. Track.
Special Committee on Standard Specification for Cement.
VIII. Masonry.
VI. Buildings.
Annual Dinner at 7:00 p. m. in Gold Room of Congress Hotel and Annex.

PROGRAM FOR THURSDAY.

Reports of Committees:
I. Roadway.
XI. Records and Accounts.
IX. Signs, Fences and Crossings.
XIV. Yards and Terminals.
New Business.
Election of Officers.
Adjournment.

At the Coliseum

The Kennicott Water Softener Co., Chicago Heights, Ill., has opened offices in New York in addition to its offices in Chicago, London and Paris. W. T. Runcie, formerly of the Tatnall Engineering Co., Philadelphia, Pa., will be in charge of this eastern office, located at suite 2072, Hudson Terminal building, 50 Church street, New York.

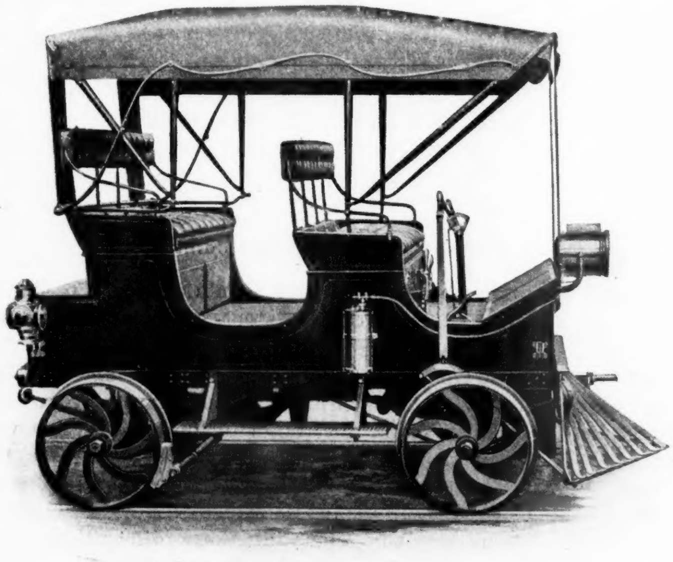
A simple and practical device that interests track men is the Bossert one-piece insulated rail joint in space 137. It seems strange, with the many devices of this kind on the market, that no one heretofore thought of this simple practical method. This joint, when closed, clamps the rail, making a solid, even surface of the rail ends. It compels the rail ends to bend uniformly, thus preventing friction or movement of the rails in a manner to cause unnecessary wear and tear of the fibre insulation. This joint is made by W. F. Bossert Manufacturing Company, Utica, N. Y.

CARNEGIE STEEL SHEET PILING IN LA SALLE STREET TUNNEL.

The statement on page 563 of yesterday's daily edition concerning the use of Lackawanna steel sheet piling in the open-cut work for the La Salle street tunnel was incorrect. The Carnegie Steel Company received the contract for 45-ft. U. S. steel piling for the approach sections and 65-ft. Friestadt piling for the cofferdam work at the ends of the river section. About 1,700 tons of this piling will be required.

BUDA INSPECTION CAR NO. 100.

One of the exhibits in the Buda company's booths at the Coliseum is its No. 100 motor inspection car. This car is intended for officials who must spend much time on inspection runs or in keeping in active touch with points along the line. No. 100 is a well finished car accommodating six passengers comfortably. Its power equipment consists of a double cylinder, horizontal opposed, water cooled motor developing 18-20 h.-p. Transmission is of the friction type with double side chain drive to the rear axles, permitting the same speed in either direction. The frame of the car is channel steel; the axles are 2 in. in diameter and run in Hyatt roller bearings; the wheels are of one-piece manganese steel; the springs are 30 in. semi-elliptical standard; the body is entirely independent of the frame and may be easily removed.

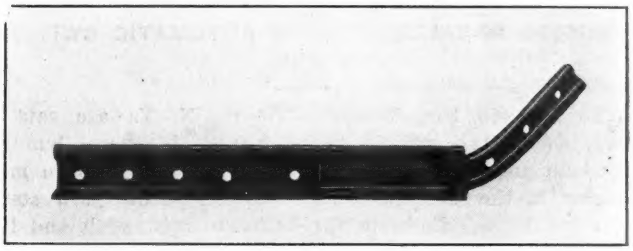


Motor Inspection Car.

THE Q. & C. BONZANO JOINT.

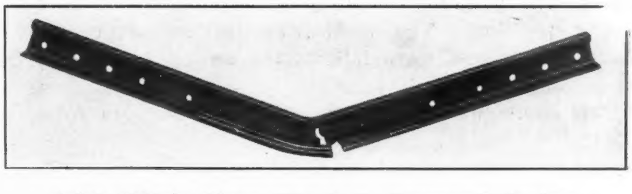
The perfect rail joint should connect the rails as a continuous girder and combine simplicity of design with sufficient strength to resist deformation or becoming permanently set, as well as to prevent deflection or vertical movement of the rail ends and at the same time provide for proper expansion.

The common angle bar, while possessing the essential qualifications of simplicity and ease of application, has not the requisite strength to meet the other essential points. The various types of reinforced joints are, for the most part, evolutions of the common angle bar. Many of them are cumbersome, having many parts and difficult of application. The Q. & C. Bonanzo joint, on the other hand, is intended to combine the simplicity and ease of application of the common angle bar with the necessary strength. Much of the deficiency attributed to rail fastenings can more properly be ascribed to either bad timber or poorly maintained joint ties, and this very fact proves that the perfect rail joint should develop sufficient strength in itself to prevent the movement of the rail ends without dependence upon the timber. This, therefore, would require to be a suspended joint of such construction and design as will develop the strength and resilience equal to the unbroken rail.



Common Angle Bar.

The Q. & C. Bonzano rail joint, or reinforced angle bar, is said to meet these requirements. The reinforcement in this joint converts it into a truss, with sufficient girder depth to sustain and transmit the moving loads, and gives the rail joint the strength and resilience required both vertically and latterly. The web feature, found only in the Bonanzo joint, presenting no abrupt change from light to heavy construction, allows the strain to be equally transmitted throughout the entire joint structure.



Joint Before Given "Q. & C. Bonzano" Design.

The accompanying illustrations are of peculiar interest, as they show the relative strength of the common angle bar, a bar containing the same amount of metal as the Q. & C. Bonzano—the joint having been given the reinforcing design—and the finished Q. & C. Bonzano joint. The comparison would seem to prove the superiority of the last named. All pieces were taken from the same section of rail and tested under a 2,000-pound hammer at an equal drop. The angle bar was destroyed at the third blow; the reinforced joint, containing the same amount of metal as the Bonzano, shows a great deflection and was fractured

at the third blow, while the finished joint shows less deflection and developed no fracture at the third blow. The adoption of the Bonzano joint, manufactured by the Q. &

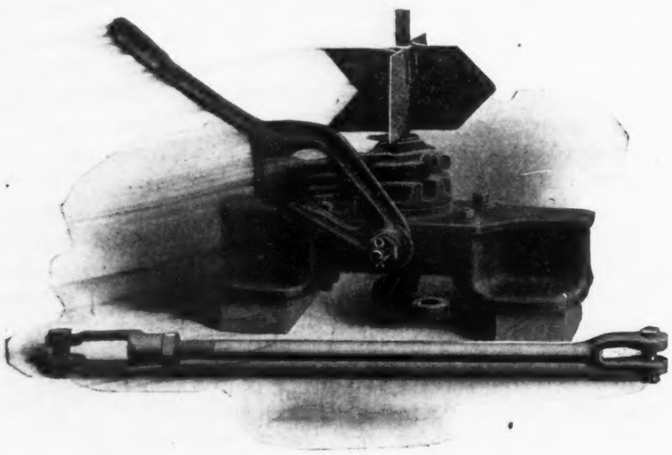
Finished "Q. & C. Bonzano" Joint.

C. Co., New York, by many of the leading railways after having been in service for several years, seems to be evidence that this joint has demonstrated its work.

RAMAPO PARALLEL THROW AUTOMATIC SWITCH STAND.

The Ramapo Iron Works, Hillburn, N. Y., are said to have, during the last 20 years, furnished several hundred thousand automatic safety switch stands. The design most popular is the company's new parallel throw yard stand, style No. 20, as shown in the halftone illustration and line sectional plan view herewith.

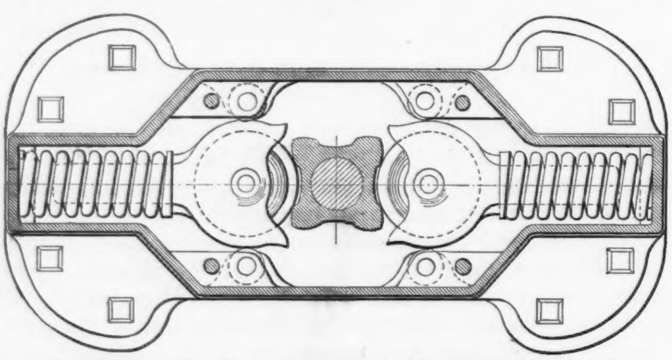
This stand is rigid for hand operation, yet is entirely automatic under the high pressure exerted by the pull on



Ramapo Safety Switch Stand, Style No. 20.

the switch points when they are trailed through, set in wrong position. The target, as in the other types of Ramapo stands, always follows the switch points and indicates absolutely their position.

This individual design, being low, compact in form, and



Horizontal Section; Ramapo Safety Switch Stand.

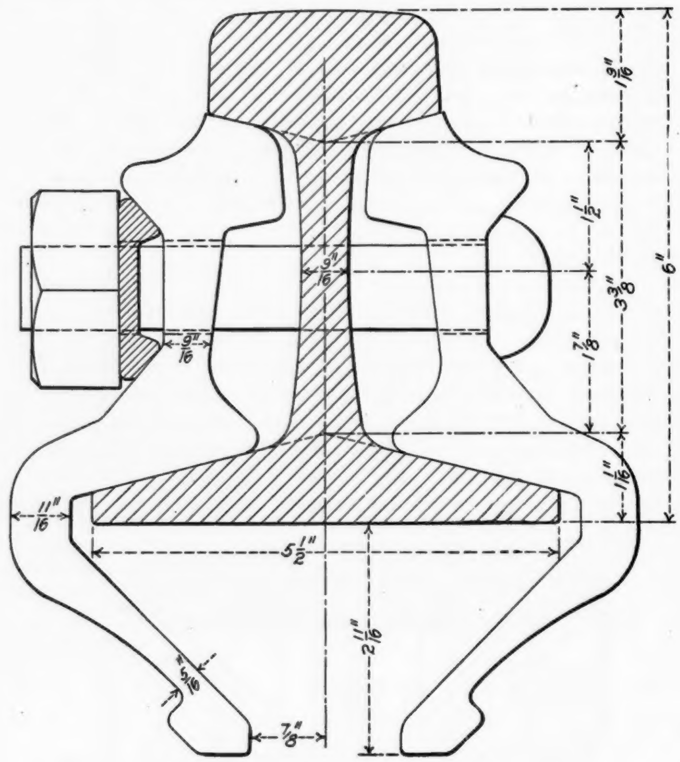
having a parallel throw, makes a very ideal yard stand. The automatic mechanism is held in position by two strong springs, either one of which is sufficient to operate the switch. The springs are only used as a reserve power, as they do not come into operation except in automatic movements.

For hand operation, one movement unlatches the stand, throws the switch and rigidly relatches it. The adjustable throw eyebolt crank and the adjustable moving rod provide the necessary adjustments, so that the stand can be used with switches of any throw. All lost motion resulting from wear on the switch points or other causes can be readily taken up.

HIGH CARBON OIL TREATED RAIL JOINTS.

The Cambria Steel Co., Philadelphia, Pa., claims to be the first steel manufacturer in the United States to successfully make rail joints of high carbon steel and high carbon steel, oil treated.

The demand for joints made of high carbon steel has led to several attempts to meet it, but little, if any, success, it is said, has resulted, mainly because the joint made of such steel could not be finished cold, due to excessive



The 100-Per-Cent. Rail Joint.

breakage and crystallization. The Cambria Steel Co., having great faith in high carbon steel for joints, decided to finish them hot. This led to many mechanical difficulties, which were overcome only by patient and intelligent experimentation. The principal trouble arose from the fact that a hot bar would not retain its original section as does a cold one, and when finished by the same process the bar would not only be distorted on its bearing surfaces, but bent vertically and latterly. A new design of the rail section overcame some of these difficulties, and new finishing methods were adopted to overcome the other defects. It is now claimed that a more perfectly finished joint is being made by the hot than was formerly made by the cold process.

The economic advantage of high carbon steel, hot finished, is that with the expenditure of about 10 per cent more than the cost of soft steel, a joint is given a carrying capacity that can be equalled only by the addition of double the quantity of metal of soft steel and at the additional cost of 100 per cent. This latter joint will cost 100

per cent more for freight, while there is no additional cost for freight in the former.

The oil treatment of steel is a natural sequence of the use of high carbon, and its advantages are about equal to those of high carbon over soft steel. This, however, varies with the section of the bar and hardness of the steel. In economy, oil treated steel is as much in advance of high carbon steel as is the latter over soft steel.

There are in successful use many 100 per cent. joints of high carbon and high carbon oil treated steel, and the opinion of those familiar with the service of these joints is adverse to again returning to the use of the old soft steel joint. Ordinary angle bars cannot be made of high carbon steel and be oil treated, since the ordinary angle bar is so limited in girder depth and sectional area that it would break rather than bend if made of high carbon steel.

REX FLINTKOTE ROOFING.

J. A. & W. Bird & Co., Boston, Mass., whose exhibit is in booth 140 at the Coliseum, are showing the well-known Rex Flintkote roofing. This roofing has been on the market about ten years, and is now classified by fire underwriters with the old style tar, gravel and metal roofs. It has been sold all over the world, being now in use on the steamboats operated by "Cook's" on the river Nile. It was used on the St. Louis Exposition buildings, safely protecting the valuable exhibits.

This roof covering is especially adapted to railway buildings, stations, train sheds, freight houses and car shops. The Southern Railway used Rex Flintkote on the train sheds of its stations at Mobile, Ala.; Birmingham, Ala., and Atlanta, Ga., after testing practically every roof manufactured in this country.

The method of fastening is a new feature, patented a few years ago, which has met with general satisfaction.

The company has issued a new book, describing this product in detail, and giving examples and results of tests to show comparison of Rex Flintkote with other roofing materials.

CAST STEEL ELECTRIC TURNABLE TRACTORS.

Among the new applications of cast steel on exhibition at the Coliseum this week is a cast steel electric tractor, by the Weir & Craig Manufacturing Co., Chicago. As shown in the accompanying illustration the frame is made of a one-piece steel casting instead of being built up of plates or

Cast Steel Electric Tractor.

rolled shapes as has been the custom. In this way the number of parts is greatly reduced and the machine made simple and compact, as well as rigid. The motor, which can be of any size or type which conditions demand, is mounted at a height which minimizes the possibility of its being damaged by water due to the pit filling up. Another important feature of its location is that it will give, due to the leverage, an increased weight on the wheel for tractive purposes.

A vertical spring, shown in the illustration, is placed in the universal bracket to absorb the shock when the locomotive comes on to the table, so the motor receives practically no jar. A leaf spring is provided between the guides at the top of the frame extending down into the inner part of the universal bracket, which can be adjusted so as to increase or decrease the traction as occasion demands.

Brackets can be attached to the sides of the frame for supporting a shelter house immediately over the tractor, or it can be located elsewhere if more convenient.

RAIL DRILLS.

The vertical, crank-operated rail drill is largely used at the present time and officials in the road department are interested in studying the merits of the various types offered. The essentials for a first class drill are ease of op-

Fairbanks-Morse Under-Rail Clamp Drill.

eration, rapidity with which track can be cleared, strength, durability and simplicity. Fairbanks, Morse & Co. have several drills in booths 35-36-37-54-55-56, which have the following points of merit. The gears which are the parts of the

Fairbanks-Morse Over-Rail Clamp Drill.

drill that are given the hardest service are of steel. A convenient means is provided by which the bit can be run up quickly to the rail after the drill is in position. This is done by placing the foot on a small lever and operating the

cranks the same as for drilling, until the tip of the bit strikes the rail. The pressure of the foot on the lever is then released and the regular drilling feed commences automatically without stopping the operation.

There are two methods of clearing the track, one by lifting an eccentric lever at the back of the drill which releases the over-rail clamp and allows the whole machine to be drawn out of the way; the other by releasing the clamp holding the top of the drill to the base, removing the top, then releasing the overrail clamp and drawing them back out of the way. The over-rail clamp is usually preferred, but the manufacturers have also designed under-rail clamps for those who desire them.

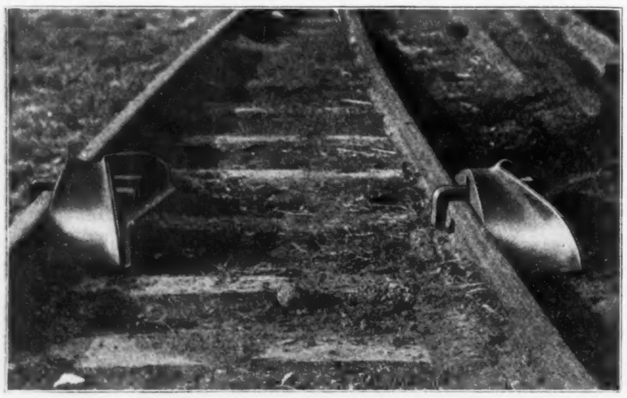
ALLITH DOOR HANGERS AND ROUND TRACKS.

The door hanger and track, illustrated herewith, is made of malleable iron and high carbon steel, carefully finished. It is designed to withstand rough treatment under all conditions of inside and outside use of sliding doors. It is made by the Allith Manufacturing Company, Chicago, and is on exhibition in booth 116 at the Coliseum.

Allith Door Hanger.

THE GUMP CAR REPLACER.

The Gump car replacer, exhibited by the W. K. Kenly Company, Chicago, in booths 78 and 79, has some new features. The principal improvements are the clamp, which holds it securely to the rail and prevents it from slipping; the shoulder, which rests against the rail and prevents overturning, and the lug on either end, which does away with the use of spikes. The Gump replacer is so made that there is practically no jar in replacing a derailed car on the track, which eliminates rail breakage.

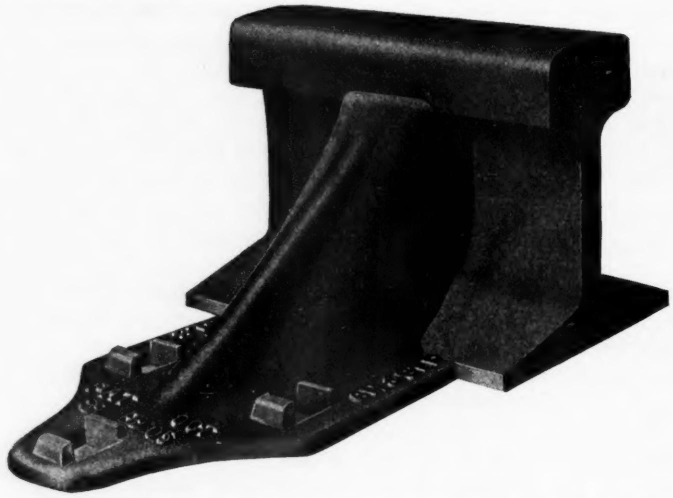


Gump Car Replacer.

The device has been favorably passed on by the testing departments of several railways.

RAIL BRACE.

The Beaver Dam Malleable Iron Co., Beaver Dam, Wis., makes a rail brace of malleable iron which has the strength of a steel brace and the advantage of better withstanding the deterioration due to the atmosphere and brine drippings from refrigerator cars. This advantage makes it especially adapted to use in yards where large numbers of refrigerator cars are handled.



The cut shows the brace as applied to the rail, and illustrates two features of merit in its design. The rib shown on the front of the brace adds strength at the point where it is most needed, and the risers at the spike holes permit the spikes to be withdrawn easily and quickly and without injury to the brace. Beaver Dam Malleable Iron Co., Rail Brace.

REFRIGERATING LINOFELT.

The Pacific Fruit Express Co. refrigerator car, shown in the illustration, is one of the 10,000 cars of that type owned by, or now on order for, that company. The insulating material in all these cars is refrigerating linofelt, a product of the Union Fibre Co., Winona, Minn.

This material is furnished in strips ½ in. thick, and in width up to 9 ft., and of any desired length. For the walls of the car the strips are applied horizontally, the length of each strip being equal to the distance from door post around to door post. Three layers were used in the P. F. E. cars, two being applied inside the frame and one outside. The roof is protected by the same thickness of insulating material, the strips being attached longitudinally. The points of merit claimed for linofelt are its efficiency, strength, durability and the ease with which it is applied. It is at present in use on over 30,000 refrigerator cars in this country. The exhibit of the Union Fibre Co. is in booth 171.

Refrigerator Car for Pacific Fruit Express.

LANTERNS.

That the advance in the improvement of railway lanterns has kept pace with the increasing and exacting demands of railway service is shown by the Adams & Westlake Co., Chicago, who are exhibiting in booths 83 and 84 lanterns with Adlake perfected ventilation, outside wick raisers and Adlake encased oil pots.

Adlake perfected ventilation was adopted after tests in which the test lanterns were carried at high speeds in blizzards, in yard service in sultry heat and in all the degrees of temperature between. Under all these condi-

Adlake Lantern.

tions the lanterns stayed lighted and gave a clear, strong signal. Lanterns were carried several nights without cleaning the globes, and gave a clear signal all the time. Adlake perfected ventilation is said to eliminate smoked globes and poor light, thus saving time in cleaning and breakage of globes due to imperfect ventilation.

The outside wick raiser is a convenient and time-saving device. The oil pot need not be removed, as a slight turn

Train-Indicating Lamp.

is all that is required to adjust the flame. The burner screws tightly into the collar of the oil pot, so the oil cannot leak out.

The Adlake encased oil pot eliminates leakage and the consequent soiling of clothes. Surrounded entirely by the guard hoop which forms the casing, the oil pot is placed in position from the top, and as the bottom is closed it cannot drop out. It dispenses with locking rivets and springs, which sometimes allow the pot to drop out, thus losing a signal.

SAFETY MAIL CRANE.

The Safety mail crane is a device for delivering mail pouches to moving trains and has the following points of merit: It insures safety to employes, and it is reliable, simple, durable and economical. The crane holds the pouch up and back from the track until released by the action of a U-shaped trip on the front tender truck which engages

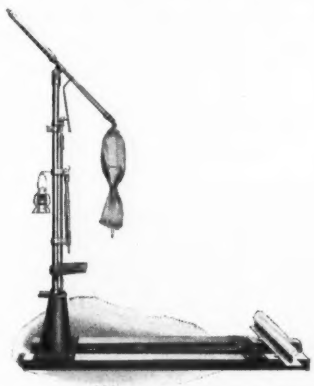


Fig. 1.

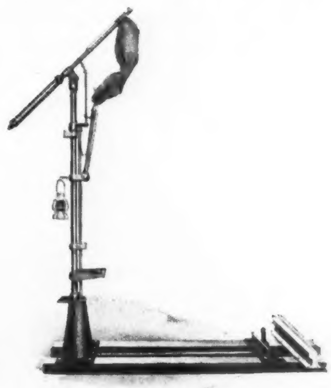


Fig. 2.

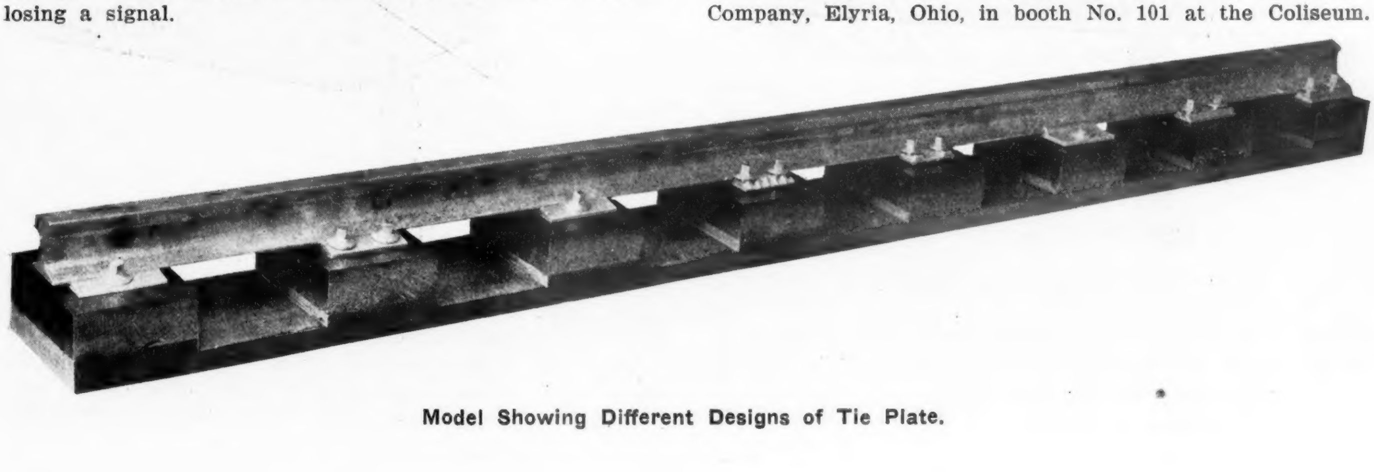
Fig. 3.

Fig. 4.

a trigger encased in a self-closing box in the track. A swivel finger and spring hold the pouch to the crane arms but allow its removal in the direction of the train movement without resistance. All parts are of steel, insuring a light, durable structure. The four cuts show the steps in the operation of the device. Burton W. Mudge & Co., Chicago are the selling agents.

SCREW SPIKE TIE PLATES.

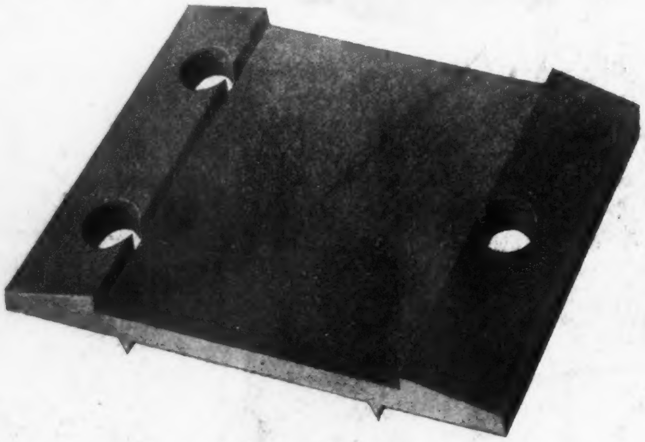
An interesting exhibit of different styles or types of rolled steel tie plates adaptable to use with screw spikes is to be seen in the tie plate display of the Hart Steel Company, Elyria, Ohio, in booth No. 101 at the Coliseum.



Model Showing Different Designs of Tie Plate.

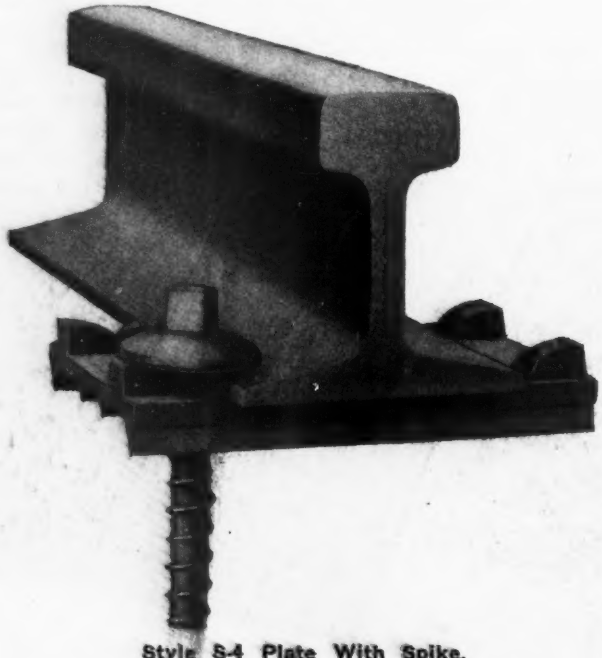
This company, which is the railway products selling organization of the Elyria Iron & Steel Company, Elyria, Ohio, exhibits a model rail and ties showing not only the five different types of this style of tie plate which they are manufacturing, but also models of the principal types in use on European roads. This model shows clearly wherein these American designs are considered superior to European types as applicable to American requirements.

The Hart Steel Company's type S-1 tie plate is designed with the idea of obtaining wide surface contact between the head of the spike and rail, this wide surface contact being obtained by inclining the screw spike, for which



Style S-3 Screw Spike Tie Plate.

practice many points of superiority are claimed. The shoulder of this plate is depressed slightly below the plane of the top of the rail flange, thereby insuring surface contact not only between the head of the spike and rail, but also between the spike and the tie plate, regardless of any excessive rolling mill variation in the flange of the rail. This plate is furnished with or without short flanges on the bottom.



Style S-4 Plate With Spike.

Style S-2 is similar to style S-1, except that it has only one shoulder, this construction permitting the easy removal of the rail. It has wide bearing surfaces to back up all of the screw spikes used, as in style S-1, and is also furnished with or without short flanges.

Style S-3, shown in halftones, is also similar to style S-1, having two shoulders, but the bearing surface for the spike head in this style is above the plane of the top of the rail flange. This permits the tie plate to be firmly held, at the same time leaving the rail loose. This plate was designed to meet the views of some engineers who contend that a loose rail will eliminate the pumping of

Style S-3 Plate With Spikes.

ballast, while at the same time the rigid fastening of the plate eliminates the chafing of ties and the rattling incidental to a loose plate.

Style S-4 is designed to meet the demand for a longitudinal flange screw spike plate and can be used expediently only with hardwood ties. Style S-5 is designed to meet the requirements of those who desire a flat bottom plate with perpendicular spike. The bosses are arranged to back up the head of the spike in any position and at the same time afford means for drainage.

Although the Hart Steel Company, in its exhibit, has

Style S-5 Plate With Spike.

given considerable prominence to the subject of the screw spike plate, it also exhibits many styles of standard types of plates for use with ordinary spikes.

Their new catalogue, No. 4, now ready for distribution, furnishes in detail much valuable information on the subject of both standard and screw spike plates.